IDENTIFICATION, EVALUATION, AND SELECTION OF WATER MANAGEMENT STRATEGIES

TEXAS STATE SENATE BILL 1

REGION B

5.1 Identified Regional Needs and Evaluation Procedures

5.1.1 Regional Needs

In Region B, (See Figure 1 Vicinity Map) water supply needs were identified for three different categories: quantity, quality and water supply system limitations. As shown on Table 5-1, a total of twelve water user groups were identified with one or more of these need categories. Only three water user groups - Electra, Vernon and Wilbarger manufacturing - were identified with quantity needs. Several municipal suppliers were found to have water quality issues, and the City of Wichita Falls may have system limitations. Since this initial evaluation of water supply was performed, many of these entities are addressing their needs. Several municipalities have constructed, or are in the process of constructing water treatment systems to solve water quality concerns. The City of Wichita Falls has begun the process to expand their water treatment capacity, and Electra is pursuing additional groundwater supplies to meet their short-term needs. This chapter will address the identified needs in context of the most recent developments by the water user groups when possible, and strategies will be evaluated only for needs that have not been resolved. Chapter 5 will also address regional strategies to improve the reliability and quality of the region's water supply.

Table 5-1

Water Users with Identified Needs

		Water Supply Needs		
User	**County**	**Quantity**	**Quality**	**System**
County Other	Baylor		X	
Seymour	Baylor		X	
Byers	Clay		X	
County Other	Clay		X	
County Other	Foard		X	
Burkburnett	Wichita		X	
County Other	Wichita		X	
Electra	Wichita	X	X	
Wichita Falls	Wichita			X
County Other	Wilbarger		X	
Manufacturing	Wilbarger	X	X	
Vernon	Wilbarger	X	X	

Note: Baylor - County Other includes Baylor Water Supply Corporation
Clay - County Other includes Charlie Water Supply Corporation
Foard - County Other includes Thalia Water Supply Corporation
Wichita - County Other includes Friberg-Cooper Water Supply Corp.
Wilbarger - County Other includes Box Community Water System, Lockett, Oklaunion Water System, and Hinds-Wildcat

5.1.2 Evaluation Procedures

For each of the identified needs water supply strategies were developed based on discussions with the water user group and the Regional Water Planning Group (RWPG) Technical Advisory Committee. In accordance with Senate Bill One (SB1) guidance, the potentially feasible strategies were then evaluated with respect to:

- Quantity, reliability and cost
- Environmental factors
- Impacts on water resources and other water management strategies
- Impacts on agriculture and natural resources
- Other relevant factors.

The other considerations listed in TAC 357.7(a), such as interbasin transfers and third party impacts due to re-distribution of water rights, were not specifically reviewed because they were not applicable to strategies identified for Region B needs.

The definition of quantity is the amount of water the strategy would provide to the respective user group in acre-feet per year. This amount is considered with respect to the user's short-term and long-term needs. Reliability is an assessment of the availability of the specified water quantity to the user over time. If the quantity of water is available to the user all the time, then the strategy has a high reliability. If the quantity of water is contingent on other factors, then reliability will be lower. The assessment of cost for each strategy is expressed in dollars for water delivered and treated for the end user requirements in acre-feet per year. Calculations of these costs follow SB1 guidelines for cost considerations, and identify capital and annual costs by decade. Project capital costs are based on 1999 price levels, and include construction costs, engineering, land acquisition, mitigation, right-of-way, contingencies and other project costs. Annual costs include power costs associated with transmission, water treatment costs, water purchase (if applicable), operation and maintenance, and other project-specific costs. For Region B projects, all debt service was calculated over 30 years at a 6 percent interest rate, except for Lake Ringgold, which was calculated over 40 years.

Potential impacts to sensitive environmental factors were considered for each strategy. Such sensitive environmental factors included wetlands, threatened and endangered species, unique wildlife habitats, effects on environmental water needs, and cultural resources. In an attempt to quantify the impact of each strategy, existing environmental reports were reviewed in addition to cursory environmental surveys in the area of the proposed project. Based on the above stated environmental factors, each strategy was evaluated and a judgement made as to whether it would be considered low impact, moderate impact, or high impact. If a strategy is selected, a more detailed environmental evaluation may be required.

The impact on water resources considers the effects of the strategy on water quantity, quality, and use of the water resource. A water management strategy may have a positive or negative effect on a water resource. This review also evaluated whether the strategy would impact the water quantity and quality of other water management strategies identified.

A water management strategy could potentially impact agricultural production or local natural resources. Impacts to agriculture may include reduction in agricultural acreage, reduced water supply for irrigation, or impact to water quality as it affects crop production. Some strategies may actually improve water quality, while others may have a negative impact. The impacts to natural resources may consider inundation of parklands, impacts to exploitable natural resources (such as mining), recreational use of a natural resource, and other strategy-specific factors.

Other relevant factors include regulatory requirements, political and local issues, public support, and time requirements to implement the strategy, recreational impacts of the strategy, and other socio-economic benefits or impacts.

Strategies for Region B were developed to provide water of sufficient quantity and quality that is acceptable for its end use. As shown on Table 5-1, water quality is a primary concern for many users in Region B. Water quality issues affect water use options and treatment requirements. For the evaluations of the strategies, it was assumed that the final water product would meet existing state water quality requirements for the specified use. For example, a strategy that provides water for municipal supply would meet existing drinking water standards, while water used for mining may have a lower quality. Strategies that improve water quality of other existing supplies, such as chloride control projects, were also considered.

A summary of all feasible strategies identified to meet needs in Region B is presented in the Strategies Matrix at the end of this chapter. The associated costs for each strategy are also summarized at the end of this chapter.

5.2 City of Wichita Falls

5.2.1 Background

The City of Wichita Falls, located in Wichita County, is a city of approximately 103,000 population. It is the largest city in a radius of about 100 miles, and the nearby communities and towns share economic and cultural ties to Wichita Falls.

Water resources are an important element in the quality of life and economic well being of the City and its citizens. Surface water reservoirs serve all the municipal, industrial, agricultural, and recreational needs of the City, in addition to numerous neighboring cities and water supply corporations.

The service area of Wichita Falls is approximately 65 percent of the entire Region B population and the municipal water demand on the Wichita Falls system accounts for approximately 65 percent of the total Region B municipal demand. With the majority of the municipal demand being dependent on the City of Wichita Falls for the next 50 years, it is imperative that management strategies be identified and evaluated to increase the system reliability.

As required by SB1 regulations, the analysis for current water supplies within the region including Lake Kickapoo and Lake Arrowhead, was based on the firm yield of the reservoirs.

Firm yield analyses determine the amount of water that is available on an annual basis during a repeat of historical drought of record condition assuming that all the water in the reservoir is available for use. Therefore, under the firm yield analyses, the reservoir is expected to approach zero sometime during the drought period. Also, the analysis is based on historical rainfall and runoff for each reservoir.

As discussed in Chapter 4 of the Region B Water Plan, experts at the University of Arizona's Climatic Assessment Project for the Southwest recently indicated that Texas could be heading into a significant dry period, which could potentially last for 20 to 30 years. If this occurs, the region may be entering a new drought period that surpasses the historical drought of record and the available water supply from Lake Kickapoo and Lake Arrowhead may be less than estimated in Chapter 3.

To provide for a more conservative estimate of the available surface water supply in Region B, a safe yield analysis was conducted for the two Wichita Falls reservoirs. This analysis utilizes the same historical hydrology as firm yield, but assumes that a one-year supply of water is reserved in the reservoir at all times. The results of the safe yield analysis for the Wichita System for the years 2000 to 2050 were estimated at 41,400 and 36,900 acre-feet per year respectively. This represents a decrease in annual supply from the firm yield analysis of approximately 18 percent by the year 2050, and will require the City to develop alternative supplies to meet their own water demands, in addition to meeting all customer contractual obligations.

Though the safe yield analysis was performed assuming a one-year supply of water remaining in the reservoirs, the City of Wichita initiates emergency drought contingency measures when the reservoir levels drop to 30 percent or 102,750 acre-feet capacity. At this stage, the remaining reserve is estimated to be three years.

Therefore, in order to maintain a minimum operational content in their reservoirs of from one to three years reserve, the City of Wichita Falls will need to consider developing alternative water supply strategies.

Finally, as Wichita Falls increases their water supply and system reliability, the City's customers who have water quality needs, including the City of Burkburnett, City of Byers, Charlie Water Supply Corporation, and Friberg Water Supply Corporation will be able to purchase additional water from the Wichita System to blend with their groundwater supply to reduce the nitrates in compliance with state regulatory requirements.

5.2.2 Water Demands

Based on the safe yield analysis shown in Table 4.11 of Chapter 4, the comparison of supply and demand indicated a short-term (through 2030) need for the Wichita System of 1,905 acre-feet per year and a long-term (through 2050) need of 4,277 acre-feet per year. This analysis assumes that a one-year supply remains in the reservoir at all times.

Should the city desire to maintain greater than a one-year reservoir system reserve and keep reservoir operating levels above the emergency drought condition trigger level of 30 percent capacity, (102,750 acre-feet) the City will need an additional water supply of 15,000 to 20,000 acre-feet per year through the year 2050.

5.2.3 Current Water Resources

The City of Wichita Falls currently utilizes two surface water reservoirs for their water supply, Lake Kickapoo and Lake Arrowhead.

Lake Kickapoo was constructed in 1946 for municipal water supply with an initial conservation capacity of 106,400 acre-feet. The reservoir is located approximately 18 miles southwest of Wichita Falls on the North Fork of the Little Wichita River in Archer County. The diversion rights from the reservoir total 40,000 acre-feet per year.

The projected firm yield of Lake Kickapoo in years 2000 and 2050 are 15,945 and 15,343 acre-feet per year respectively, and the projected safe yield of the lake in years 2000 and 2050 is 12,400 and 11,900 acre-feet per year respectively.

Raw water is conveyed from Lake Kickapoo to the secondary reservoir located in Wichita Falls through 18 miles of 39" transmission line. The main pump station is located at the dam with three intermediate booster stations along the route of the transmission line. The estimated maximum pumping capacity of the system is 27,500 acre-feet per year (25 MGD).

Lake Arrowhead was constructed in 1966 for municipal, industrial, and recreational use with an initial conservation capacity of 262,100 acre-feet. The reservoir is located approximately 10 miles southeast of Wichita Falls on the Little Wichita River in Clay County. The diversion rights from the reservoir total 45,000 acre-feet per year.

The projected firm yield of Lake Arrowhead through the year 2050 is 29,532 acre-feet, and the projected safe yield of the lake for the years 2000 and 2050 is 29,000 and 25,000 acre-feet per year respectively.

Raw water is conveyed from Lake Arrowhead to the secondary reservoir in Wichita Falls through 10 miles of 54" transmission line. The main pump is located at the dam with an estimated maximum pumping capacity of 50 MGD.

Therefore, the combination of Lake Kickapoo and Lake Arrowhead (Wichita System) has a safe yield for the years 2000 and 2050 of 41,400 and 36,900 acre-feet per year respectively. The maximum combined pumping capacity from the two lakes is estimated at 82,500 acre-feet per year (75 MGD).

5.2.4 Review of Alternative Water Supply Strategies

In consultation with the RWPG Technical Advisory Committee, four sources of additional water supply for the City of Wichita Falls were considered and are listed below:

- Wastewater Reuse - Approximately 11,000 acre-feet per year (10 MGD) of processed and treated effluent could be used for irrigation and industrial purpose or mixed with existing raw water supply at the secondary reservoir.

- Lake Kemp/Diversion - Approximately 25,150 acre-feet per year (23 MGD) of Kemp/Diversion water could be treated at the existing Cypress Water Treatment Plant (WTP) for municipal use.
- Lake Ringgold - Approximately 27,000 acre-feet per year (24.5 MGD) could be made available for municipal use by constructing a new lake near Ringgold.
- Regional Lake Kemp/Diversion Desalination Plant - 25,150 acre-feet per year (23 MGD) of Kemp/Diversion water could be treated at a new facility located near Lake Diversion for regional distribution.

5.2.5 Description of Potentially Feasible Alternatives

Each of the potentially feasible alternatives is described below and is shown in Figure 2.

Alternative WF-1: Wastewater Reuse

<u>Quantity, Reliability, and Cost</u>

Currently the City of Wichita Falls operates and maintains a wastewater treatment plant that discharges approximately 14,300 acre-feet per year (13 MGD) of very high quality treated effluent into the Wichita River for use downstream by other entities. This water would be a very reliable source for the City, and could be utilized to decrease the irrigation and industrial demands on the system, and/or to increase the municipal water by 11,000 acre-feet per year (10 MGD). To produce 10 MGD of reusable water, this alternative would require advanced treatment at the River Road Wastewater Treatment Plant (RRWWTP) including denitrification, microfiltration, and ultraviolet (UV) disinfection. In addition, a 30-inch pipeline and 10 MGD pump station will be required to convey the water to the secondary reservoir prior to the final water treatment process and storage in an additional reservoir at the Jasper WTP. A summary of the capital and annual costs are presented below.

Alternative WF-1 Wastewater Reuse

Construction Costs	
RRWWTP Denitrification Improvements	$6,000,000
Microfiltration Treatment	7,000,000
UV Disinfection	2,000,000
RRWWTP Pump Station	1,500,000
30" Pipeline to Secondary Reservoir (12 miles)	7,000,000
Storage Reservoir at Jasper WTP	1,500,000
10 MGD Pump Station and Water Treatment	9,000,000
Subtotal Construction Costs	$34,000,000
Other Project Costs	
Engineering, Legal, Financial, & Contingencies	$11,550,000
Land and Easements	100,000
Environmental Studies, Mitigation & Permitting	400,000
Interest During Construction (18 Months)	2,650,000
Subtotal Other Costs	$14,700,000
Total Capital Project Costs	**$48,700,000**
Annual Costs	
Debt Service (30 yrs. @ 6%)	$3,540,000
Operation and Maintenance	158,000
Power Costs (Pumping Facilities)	125,000
Water Treatment Costs ($0.50/1,000 Gal.)	1,792,000
Total Annual Cost	**$5,615,000**
Available Water Yield (Acre-Feet Per Year)	11,000
Available Water Yield (MGD)	10
Cost of Water Delivered ($ Per Acre-Feet)	**$510**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$1.57**

Environmental Factors

This alternative would have low to moderate impacts on the environment since the pipeline route could be routed along the Holliday Creek Flood Control Project. In addition, the pump station would be located at the existing wastewater plant in an area of minimal impact.

Impact on Water Resources and Other Management Strategies

This alternative would have a low to moderate impact on the Wichita River in that the wastewater effluent would no longer be discharging into the river. During drought conditions this could cause a noticeable effect on the quantity and perhaps the quality of water in the Wichita River immediately downstream from the wastewater plant.

In addition, this alternative would reduce the quantity of water required from Lake Arrowhead and Lake Kickapoo reservoirs, and could significantly delay the need to construct Lake Ringgold.

Impact on Agriculture and Natural Resources

This alternative would have minimal to no impact on agriculture and natural resources, in that the route for the transmission pipeline is along a flood control creek. Also, though the flow from the treatment plant into the river would be significantly reduced, the effect would be minimal compared to the total flow of the river.

Other Relevant Factors

Public acceptance of this alternative may become an issue if perception prevails that properly treated wastewater effluent is a questionable source of raw water supply for the City due to unfounded health concerns or other misconceptions. In addition, this alternative will require a modification to the wastewater discharge permit which could take 1 to 2 years.

Alternative WF-2: Water from Lake Kemp/Diversion Reservoirs

Quantity, Reliability, and Cost

The City of Wichita Falls currently has water rights to 25,150 acre-feet of Kemp/Diversion water for municipal use. However, due to the high salinity content of the water, the City has not utilized it as a municipal water supply. Aside from water quality, this reservoir system would be a very reliable source of water supply in that it is in a different drainage basin than Lake Arrowhead and Lake Kickapoo.

To utilize 11,000 acre-feet per year (10 MGD) of Kemp/Diversion water, a pump station and approximately 13 miles of 42" transmission line would be required to convey the water from the reservoir system to the Cypress WTP located on the southwest side of Wichita Falls. In addition, Cypress WTP improvements will be required to include microfiltration and reverse osmosis for enhanced treatment of the high salinity water. Facilities will also need to be constructed for reject brine disposal into the Wichita River. A summary of the capital and annual costs is presented below.

Alternative WF-2 Water from Lake Kemp/Diversion Reservoirs

Construction Costs	
12 MGD Pump Station Near Diversion	$2,000,000
42" Raw Water Line to Cypress Plant (13 miles)	15,500,000
10 MGD Microfiltration/Reverse Osmosis Treatment	22,500,000
Treatment Brine Reject Disposal	2,500,000
Subtotal Construction Costs	$42,500,00
Other Project Costs	
Engineering, Legal, Financial & Contingencies	$14,100,000
Land and Easements	160,000
Environmental Studies, Mitigation, & Permitting	500,000
Interest During Construction (18 months)	3,300,000
Subtotal Other Costs	$18,060,000
Total Capital Project Costs	**$60,560,000**
Annual Costs	
Debt Service (30 yrs. @ 6%)	$4,403,000
Operation and Maintenance	205,000
Power Costs (Pumping Facilities)	50,000
Water Treatment Costs ($0.75/1,000 Gals .)	2,688,000
Total Annual Cost	**$7,346,000**
Available Water Yield (Acre-Feet Per Year)	11,000
Available Water Yield (MGD)	10
Cost of Water Delivered ($ Per Acre-Feet)	**$668**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.05**

<u>Environmental Factors</u>

This alternative would have low to moderate impacts on the environment assuming the pipeline routes could be routed along highways or county roads. In addition, the pump station can be located in an area of minimal environmental impact. It is anticipated that the brine discharge will be into the Wichita River.

<u>Impact on Water Resources and Other Management Strategies</u>

This alternative would have a low to moderate impact on the Lake Kemp/Diversion system, in that the water levels in the lakes may have greater fluctuations as more water is utilized from this system. Also with the brine discharge into the Wichita River, the chloride content of the river may be impacted.

The quantity of water required from Lake Arrowhead and Lake Kickapoo reservoirs would be reduced using this alternative and could significantly delay the need to construct Lake Ringgold.

Impact on Agriculture and Natural Resources

This alternative would have a low to moderate impact on agriculture and natural resources, depending on the pipeline route selected.

Other Relevant Factors

This alternative would require the mixing of conventional treated water and water treated through a desalination process. Proper mixing and compatibility of the waters should be a consideration.

Alternative WF-3: Construct Lake Ringgold Reservoir

Quantity, Reliability, and Cost

In the early 1980's the City of Wichita Falls identified a potential reservoir site approximately 40 miles northeast of Wichita Falls, near the town of Ringgold. The site would be on the Little Wichita River and studies have concluded that, if constructed approximately 27,000 acre-feet per year (24.5 MGD) of water could be made available for municipal use.

This reservoir would be in the same drainage basin as Lake Arrowhead and Lake Kickapoo so it is anticipated that the water quality would be very similar to the existing reservoirs. The reliability of this water supply would be good, however, with the location of the Ringgold site being downstream and in the same drainage basin as the two existing lakes, the Ringgold Reservoir could be adversely affected during periods of extended drought. Also instream flow requirements for new reservoirs will most likely reduce the estimated firm yield.

Of the 17,000 acres of land needed for the reservoir site, the City currently owns approximately 5,000 acres. Along with purchasing the remaining lands for the site, additional facilities including a lake intake structure, pump station facilities, and 40 miles of 54" transmission line would be required to convey 27,000 acre-feet per year (24.5 MGD) of raw water into existing treatment facilities in Wichita Falls. A summary of the capital and annual costs are presented below.

Alternative WF-3 Construct Lake Ringgold Reservoir

Construction Costs	
Ringgold Reservoir (275,000 Acre-Feet Capacity)	$58,860,000
Pumping Facilities (2-24.5 MGD)	6,000,000
54" Raw Water Line to Storage. Reservoir (40 miles)	73,500,000
24.5 MGD Pumping Facility @ Storage Reservoir	3,000,000
24.5 MGD Water Treatment Facility	18,375,000
Subtotal Construction Cost	$159,735,000
Other Project Costs	
Engineering, Legal, Financial, & Contingencies	$52,232,000
Land and Easements	13,000,000
Environmental Studies, Mitigation & Permitting	15,000,000
Interest During Construction (5 years)	47,487,000
Subtotal Other Cost	$127,719,000
Total Capital Project Cost	**$287,454,000**
Annual Costs	
Debt Service (Reservoir 40 yrs. @ 6%)	$9,558,000
Debt Service (Pipeline/Pump Sta. 30 yrs. @ 6%)	10,449,000
Operation & Maintenance	1,818,000
Power Cost (Pumping Facilities)	600,000
Water Treatment Costs ($0.25/1,000 Gal.)	2,199,000
Total Annual Cost	**$24,624,000**
Available Water Yield (Acre-Feet Per Year)	27,000
Available Water Yield (MGD)	24.5
Cost of Water Delivered ($ Per Acre-Feet)	**$912**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.80**

<u>Environmental Factors</u>

This alternative would have a moderate impact on the environment with the inundation of over 9,000 acres of existing pasture land. In addition, pump stations and the pipeline into the City should be located in areas of low to moderate impact.

Impact on Water Resources and Other Management Strategies

This alternative would have a high impact on the water resources of the City in that an additional 275,000 acre-feet of reservoir storage would be created while increasing the water supply to Wichita Falls by 27,000 acre-feet per year.

Though this alternative is the most expensive strategy, it would likely delay the need for the wastewater reuse project and/or the Lake Kemp/Diversion project beyond the year 2050.

Impact on Agriculture and Natural Resources

This alternative would have a moderate to high impact on agriculture in that well over 9,000 acres of pasture land or potential farmland would be inundated by the reservoir.

Also, it is anticipated that the average daily flow in the Red River downstream of the Little Wichita River will be diminished significantly.

Other Relevant Factors

This alternative would require the City to obtain a permit from the Texas Natural Resource Conservation Commission (TNRCC) to impound water from the Little Wichita River. Since the City of Wichita Falls already has approximately 25,000 acre-feet of water rights in Lake Kemp/Diversion that are not currently being utilized, the burden of proof will be on the City to justify the need for this permit.

Depending on the availability of the land, permitting issues, and environmental issues, this project could take 8 to 10 years to complete.

Regional Water Treatment Plant Alternative (Lake Kemp/Diversion Reservoirs)

This alternative is based on the City of Wichita Falls, City of Vernon, and the City of Electra participating in a regional plan to utilize Lake Kemp/Diversion and construct a desalination plant at the reservoir site. The regional plan is addressed in detail in Section 5.6 of this chapter, with the following costs allocated to the City of Wichita Falls as summarized below.

Total Regional Capital Project Cost	**$129,336,000**
City of Wichita Falls Portion (74%)	**95,709,000**
Annual Cost	
Debt Service (30 yrs. @ 6%)	$6,958,000
Operation and Maintenance	325,000
Power Cost (Pumping Facilities)	75,000
Water Treatment Costs ($0.75/1,000 Gals)	3,494,000
Total Annual Cost	**$10,852,000**
Available Water Yield (Acre-Feet Per Year)	14,300
Available Water Yield (MGD)	13
Cost of Water Delivered ($ Per Acre-Feet)	**$759**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.33**

5.3 City of Vernon

5.3.1 Background

The City of Vernon is located in Wilbarger County in north Texas near the Texas/Oklahoma border. It is the largest city in the county with a population of about 12,500, which accounts for 80 percent of the total county population. As a result, the City of Vernon provides a large portion of the county's municipal water needs and nearly all of the county's industrial water needs. Vernon currently obtains all of its water supply from wells in the Seymour Aquifer, mostly located north of the city. The supply and demand comparisons presented in Chapter 4 indicate that the long-term reliable supply from the City's existing well fields may not meet increasing demands. Also, water from the City's wells in the Seymour Aquifer has elevated nitrate levels, which are often slightly in excess of the U.S. EPA primary drinking water standard of 10 milligrams per liter (mg/l) of nitrate as nitrogen.

Vernon provides water to local water supply corporations including Box Community Water System, Hinds-Wildcat, Northside, Oklaunion WSC and a small amount of water to the Lockett Water System. Each of these entities, with the exception of Northside, also has reported nitrate levels above the primary drinking water standard. In response to the nitrate levels in their water supply, the City of Vernon has begun the design and construction of a nitrate removal system. An ion-exchange system should be completed and in operation by 2002. This system is capable of providing up to 5 MGD of treated blended water for Vernon and its customers. Box Community and Oklaunion water systems will then purchase the treated water blend from Vernon, solving their water quality issues. However, the infrastructure for the Hinds-Wildcat system is not currently designed to supply treated water from the proposed plant location, and Hinds-Wildcat will continue to receive water directly from the well field. Also, the City of Vernon provides only a portion of Lockett's water needs. Continued purchase of a small amount of treated water will not significantly reduce the nitrate levels in Lockett's water supply. It is anticipated that Lockett will purchase low-nitrate treated water from Vernon by 2010 to blend with their existing supply.

Vernon is currently addressing the nitrate issues in its supply and the supply for some of its customers. Therefore, no additional water quality strategies will be identified for the City of Vernon, Box Community Water System and the Oklaunion Water System. However, water quality strategies will be identified for Hinds-Wildcat and Lockett since existing infrastructure does not readily support the purchase of treated water from the City of Vernon. The strategies identified for Vernon will focus on providing water supply for the City and manufacturing needs in Wilbarger County.

5.3.2 Water Demands

The comparison of supply and demand indicated short-term and long-term supply needs for the City of Vernon and manufacturing in Wilbarger County. Since the City of Vernon provides nearly all of the water for county manufacturing, the water needs for both user groups will be examined together. The total short-term need (through 2030) for Vernon and manufacturing is estimated at 433 acre-feet per year, and the long-term need (by 2050) is 612 acre-feet per year. The analysis shows an immediate need in the year 2000, which can be temporarily met by overdrafting the City's existing groundwater sources and implementing conservation. However, additional water supplies will most likely be needed within the next decade.

5.3.3 Current Water Resources

The City of Vernon currently uses groundwater from two principal well fields, the Odell and Winston well fields. The Odell water supply wells are located approximately 12 miles north of the City and the Winston wells are located 2 miles north of the Odell field. Water from these wells is pumped to a central storage tank at the Odell field, and then flows by gravity to the City for distribution. Since these well fields are operated as a single supply source, they are referred to collectively as the Odell-Winston well field. The reliable long-term yield of this system is approximately 2,800 acre-feet per year. Additional water supply wells are located within the city limits. These city wells have been used as needed to meet peak demands in the summer. The yield of the in-city wells is estimated at 560 acre-feet per year.

To reduce its demand on the Odell-Winston well field, Vernon has begun to use local wells for irrigation of parks and golf courses. Vernon is also proposing to directly connect Rhodia Industries to the City's existing in-city well field. The in-city wells have high nitrate levels, which are undesirable for municipal use but do not affect the manufacturing use for Rhodia. These modifications will reduce the amount of water that is required for treatment.

5.3.4 Review of Alternative Water Supply Strategies

In consultation with the RWPG Technical Advisory Committee and city staff, ten sources of additional water supply for the City of Vernon were considered:

Treated surface water from

- Altus, Oklahoma
- Wichita Falls

Raw surface water from

- Altus, Oklahoma
- Wichita Falls
- A new dam on Wildcat Creek
- A new dam on Beaver Creek
- Lake Diversion (with desalination)

Additional groundwater from

- Round Timber Ranch Well Field (Altus, Oklahoma) or develop a new well field
- Enhanced recharge for existing well fields
- Industrial Reuse

Treated and raw surface water from the City of Altus was eliminated because Altus does not want to sell any of its surface water from Tom Steed Reservoir. The comparative cost of these options is high because of the purchase costs, and the water would have to be transported 35 miles across the Red River.

Two potential reservoir sites were reviewed as possible new sources of water. The dam on Beaver Creek would provide approximately 2,500 acre-feet per year of fair quality water. The Wildcat Creek site would provide about 1,700 acre-feet per year of fair to poor water quality. Both of these alternatives were eliminated because building such impoundments would be very expensive and the supply may not be reliable. Permitting complexities would be high for a new reservoir, as would the institutional difficulties.

Industrial reuse would add an uncertain amount of fair to poor quality water to the City's existing water supply. Permitting complexities are expected to be moderate, but the institutional difficulties would be high. This option was eliminated because existing industries have indicated that they are not interested in industrial reuse.

Recharge rates of the Seymour Aquifer near Vernon's existing well fields may be increased by building small dams and infiltration wells in surface water drainage areas. An enhanced recharge program would add an uncertain amount of water to the City's existing supply. However, during a drought the reliability is low and the quantity is small. Therefore, this strategy was not retained for detailed evaluation for additional water supply. The City of Vernon may still choose to develop an enhanced recharge program to increase the reliability of its existing supply, but this option alone would not provide sufficient supply to meet the projected needs.

The alternative strategies retained for detailed analysis are shown in Figure 3 and include:

- Purchase treated surface water from the City of Wichita Falls
- Purchase raw surface water from Lake Kickapoo
- Purchase groundwater from the City of Altus (Round Timber Ranch)/ or develop new groundwater well field
- Purchase water from Lake Kemp/Diversion with desalination (regional option)

5.3.5 Description of Potentially Feasible Alternatives

Alternative V-1: Treated Surface Water from Wichita Falls

The City of Vernon would purchase up to 2 MGD of treated water from the City of Wichita Falls. The estimated purchase cost would be about $0.95 per thousand gallons. Water would be pumped approximately 42 miles to the City's existing 1.5-MG central storage tanks via an 18-inch pipeline from the existing Iowa Park pump station located east of the City of Iowa Park. The transmission pipeline would generally follow the right-of-way for Highway 287, crossing approximately 7 major roads/highways. A new pump station with a metering vault would be located at the Iowa Park station. A booster station and 0.5-MG storage tank would be located along the route (approximately 30 miles west of Wichita Falls). This water would not require additional treatment.

Alternative V-2: Raw Surface Water from Lake Kickapoo

The City of Vernon would purchase up to 2 MGD of raw surface water from the City of Wichita Falls. The estimated purchase cost would be about $0.21 per thousand gallons. Water would be pumped approximately 45 miles via an 18-inch pipeline from Lake Kickapoo to a new surface water treatment plant. The transmission pipeline would generally follow a rural route, crossing approximately 6 roads/highways and 1 railroad. This alternative would require the construction of an intake structure and a new pump station with metering vault at Lake Kickapoo, and a booster station with a 0.5-MG storage tank. It also would require constructing a new 2-MGD surface water treatment plant.

Alternative V-3: Groundwater from Round Timber Ranch well field

The City of Altus is considering leasing their right to pump water from the Round Timber Ranch to the City of Vernon. The Round Timber Ranch is located in Wilbarger County, Texas, near the Texas-Oklahoma border. This option would include re-development of 13 existing water wells, new well controls and pumps, and a new pumping station. The water would be pumped from the well field to a new 0.5-MG storage tank. From the tank the water would be pumped approximately 11.5 miles through a new 14-inch transmission line to the Odell-Winston storage tank. The groundwater would then be transported to the City's treatment plant via an existing 21-

inch pipeline. Previous water quality data indicate the Round Timber groundwater has nitrate levels at or just below the 10 mg/l limit. It is assumed that water from the Round Timber well field would be combined with the existing Odell-Winston water and treated for nitrates at a similar treat/blend ratio. No additional treatment system will be required.

Regional Water Treatment Plant Alternative (Lake Kemp/Diversion Reservoirs)

A regional water supply project using Lake Kemp/Diversion water with desalination could provide the City of Vernon with 2 MGD of treated water. At Lake Diversion, the water would be treated by reverse-osmosis, and then pumped to the City of Vernon via a regional pipeline system to an existing 1.5-MG storage tank in Vernon. Further description of this alternative is presented in Section 5.6.

5.3.6 Analysis of Viable Strategies

Alternate V-1: Treated Surface Water from Wichita Falls

Quantity, Reliability and Cost

The quantity of water (2,200 acre-feet per year) would be sufficient to meet the City of Vernon's needs and projected needs for manufacturing in Wilbarger County. The City of Wichita Falls has sufficient water to provide to Vernon, but they have limited treatment capacity. Wichita Falls is currently expanding their water treatment plant by 20 MGD, which would be sufficient to provide treated water to Vernon. The reliability would be moderate since the supply is contingent on Wichita Falls' water supply, and Wichita Falls may limit their customers' supply during drought. The water cost for this alternative is estimated at $2.83 per 1,000 gallons. These costs are moderately high due to the long pipeline needed to transport the water from the Iowa Park pump station to Vernon. A summary of the capital and annual costs are presented below.

Alternative V-1 Treated Water from Wichita Falls

Construction Costs	
18" Pipeline	$9,536,000
ROW costs	504,000
Pump Station (includes booster station and .5 MG storage tank)	630,000
Highway Crossings	126,000
Metering Vaults	16,000
Subtotal Construction Costs	$10,812,000
Other Project Costs	
Mitigation & Permitting	$324,000
Engineering/ Contingencies	3,244,000
Interest during construction	1,124,000
(24 month construction period)	
Subtotal Other Costs	$4,692,000
Total Capital Project Costs	**$15,504,000**
Annual Costs	
Debt Service (30 years @ 6%)	$1,126,000
Operation and Maintenance	111,000
Pumping costs	101,000
Treatment Costs	$0
Water Purchase Costs	694,000
Total Annual Costs	**$2,032,000**
Available Water Yield (Acre-Feet Per Year)	2,200
Available Water Yield (MGD)	2
Cost of Water Delivered ($ Per Acre-Feet)	**$923**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.83**

Environmental Factors

Potential environmental impacts should be low since the route of the pipeline will generally follow Highway 287. The booster station required along the route can be located in an area of minimal environmental impact.

Impacts on Water Resources and Other Water Management Strategies

There should be low water resources impacts since the Wichita System has adequate yield. However, water levels in the lakes may have greater fluctuations as more of the system's yield is used. This may affect local lake owners and/or businesses on the lake. Other strategies that may be affected include the sale of water from Wichita Falls to Electra via an existing pipeline to Iowa Park. This pipeline has sufficient capacity for the existing supply to Iowa Park and the City of Vernon, but it most likely cannot supply Electra, Vernon and Iowa Park. Also, if Iowa Park utilizes its full contract amount from Wichita Falls, an additional transmission line may be needed to supply Vernon.

Impacts on Agriculture and Natural Resources

This strategy has minimal impacts on agriculture and natural resources. Since the pipeline follows an existing highway, there should be no impacts to agricultural lands and there are no identified natural resources along the route. The water sold to Vernon from Wichita Falls is designated for municipal use and should not affect irrigation supply

Other Relevant Factors

This strategy could be implemented between 2 and 5 years to meet Vernon's short-term and long term needs. The permitting and regulatory requirements are expected to be few. At a minimum, a nationwide 404 permit and an NPDES storm water permit during construction would be required for the pipeline. As the pipeline route is finalized, additional coordination with state and local agencies regarding sensitive environmental factors may be needed. Also, if the pipeline affects state-owned lands, additional permits and/or a Grant of Easement may be required. This strategy would increase Wichita Falls' prominence as a regional water provider and may provide means for additional supply for growth after 2050. However, the City of Wichita Falls is currently rationing water in compliance with their drought contingency plan. The City may not be receptive to providing water to Vernon until additional water supply alternatives are developed.

Alternate V-2: Raw Surface Water from Wichita Falls

Quantity, Reliability and Cost

As with Alternate V-1, the quantity of water would be sufficient to meet the City of Vernon's needs and projected needs for manufacturing in Wilbarger County. The reliability is moderate since it is contingent on the firm yield of the Wichita system, and may be subject to rationing during drought conditions. The costs for this alternative are estimated at $2.92 per 1,000 gallons. This is moderately high due to the long pipeline needed to transport the water from Lake

Kickapoo to Vernon, and the construction of a surface water treatment plant. Operation of the water treatment plant would require additional city staff. Also, since the City of Vernon has made a commitment to the nitrate removal system, the City would need to maintain two different treatment systems.

Alternative V-2 Raw Water from Wichita Falls

Construction Costs	
18" Pipeline	$10,217,000
ROW costs	540,000
Pump Station (includes booster station and .5 MG storage tank)	600,000
Crossings	136,000
Treatment Plant (2 MGD)	4,500,000
Kickapoo Intake structure/ metering vaults	1,016,000
Subtotal Construction Costs	$17,009,000
Other Project Costs	
Mitigation & Permitting	$510,000
Engineering/ Contingencies	1,700,000
Interest during construction (24 month construction period)	1,502,000
Subtotal Other Costs	$3,712,000
Total Capital Project Costs	**$20,721,000**
Annual Costs	
Debit Service (30 years @ 6%)	$1,506,000
Operation and Maintenance	117,000
Pumping costs	74,000
Treatment Costs	251,000
Water Purchase Costs	147,000
Total Annual Costs	**$2,095,000**
Available Water Yield (Acre-Feet Per Year)	2,200
Available Water Yield (MGD)	2
Cost of Water Delivered ($ Per Acre-Feet)	**$952**
Cost of Water Delivered ($ per 1,000 Gallons)	**$2.92**

<u>Environmental Factors</u>

The environmental impacts should be low to moderate depending on the route of the pipeline. It is assumed that the pipeline will travel in a direct route from Lake Kickapoo to Vernon. The booster station required along the route can be located in an area of minimal environmental impact.

Impacts on Water Resources and Other Water Management Strategies

There should be no water resources impacts since the Wichita System has adequate yield. However, water levels in the lakes may have greater fluctuations as more of the system's yield is used. This may affect local lake owners and/or businesses on the lake. This strategy should not affect identified strategies for other users. The Wichita System has sufficient yield to supply both Vernon and Electra, and the City of Wichita Falls is reviewing strategies to further increase the reliability of this system.

Impacts on Agriculture and Natural Resource

The impacts to agriculture should be low since the water from Lake Kickapoo is designated for municipal use. There may be some minimal impacts to agricultural lands to allow for the right of way easement since the pipeline may not follow highways. Potential impacts to natural resources should be low. The pipeline could be routed to minimize impacts to natural resources.

Other Relevant Factors

This strategy could be implemented between 3 and 5 years to meet Vernon's needs. The permitting and regulatory requirements would be low to moderate. A Corps of Engineers 404 permit would be required for the raw water intake structure at Lake Kickapoo and the 45-mile transmission pipeline. With the present transmission route, the pipeline crosses several streams, including the Wichita River and Beaver Creek. As the pipeline route is finalized, additional coordination with state and local agencies regarding sensitive environmental factors may be needed. If the pipeline affects state-owned lands, additional permits and/or a Grant of Easement may be required. Also, the surface water plant design will require TNRCC approval. During construction, a storm water NPDES permit will be required. As with Alternative V-1, this strategy may provide means for additional supply for growth after 2050, but may be contingent on Wichita Falls developing additional supply.

Alternate V-3: Groundwater from Round Timber Ranch

<u>Quantity, Reliability and Cost</u>

A preliminary assessment of the groundwater supply at the Round Timber ranch well field indicates that the well field could sustain an average water supply rate of 1.2 MGD, assuming average recharge conditions. During a drought, it is estimated that the well field could supply 1,100 acre-feet per year. This supply would be adequate to meet Vernon's projected needs through 2050, but may be able to provide for growth beyond 2050. The reliability is moderate to high, depending on local recharge and other groundwater use. The cost for this alternative is $1.16 per 1,000 gallons, depending on the purchase price from the City of Altus. This is relatively low because a pipeline would be needed only to the existing Odell-Winston well field, and the well field is already developed. A summary of the cost estimate follows.

Alternative V-3 Round Timber Well Field

Construction Costs	
Study of well field	$150,000
14" Pipeline	2,125,000
ROW costs	138,000
Pump Station with 0.5 MG storage tank	410,000
Crossings, metering vaults and well field tie-in	113,000
Re-development of wells/ testing/ pumps/ well controls	300,000
Subtotal Construction Costs	$3,236,000
Other Project Costs	
Mitigation & Permitting	$93,000
Engineering/ Contingencies	309,000
Interest during construction (12 month construction period)	145,000
Subtotal Other Costs	$547,000
Total Capital Project Costs	**$3,783,000**
Annual Costs	
Debit Service (30 years @ 6%)	$275,000
Operation and Maintenance	27,000
Pumping costs	19,000
Treatment Costs	53,000
Water Purchase Costs	55,000
Total Annual Costs	**$429,000**

Available Water Yield (Acre-Feet Per Year)	1100
Available Water Yield (MGD)	1
Cost of Water Delivered ($ Per Acre-Feet)	**$390**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$1.19**

Environmental Factors

The environmental impacts would be low because the pipeline route would follow existing roadways and the well field is already in place. The waste stream from the nitrate removal system would be treated at the City's wastewater treatment plant.

Impacts on Water Resources and Other Water Management Strategies

There should be few impacts to water resources. The availability of water from the Seymour Aquifer is adequate to meet this additional demand. There are no other strategies that would be affected.

Impacts on Agriculture and Natural Resources

Threats to agriculture would be low since the well field has historically been used for municipal water supply, not farming. Also the projected demands for irrigation in Wilbarger County are expected to decrease over the planning period.

Other Relevant Factors

This strategy could be implemented between 2 and 3 years. The permitting and regulatory requirements are expected to be few. A nationwide 404 permit would be required for the transmission pipeline from the Round Timber Ranch to the Odell well field. A storm water NPDES permit will be required during construction. Since the pipeline route generally follows existing roads, it is unlikely that additional permitting will be required. However, when the pipeline route is finalized, additional coordination with state and local agencies regarding other permitting or review requirements should be conducted. Since the quality of the groundwater is moderate, it is assumed that the water will require treatment for nitrates. Vernon is constructing a nitrate removal system for its existing supply, and the plant is designed for expansion as needed.

Also, the City of Vernon is already using groundwater and additional groundwater supply would complement its existing system.

Regional Water Treatment Plant Alternative (Lake Kemp/Diversion Reservoirs)

This strategy is based on the City of Wichita Falls, City of Vernon, and the City of Electra participating in a regional plan to utilize Lake Kemp/Diversion and construct a desalination plant at the reservoir site. The regional plan is addressed in detail in Section 5.6 of this chapter with the following costs allocated to the City of Vernon as summarized below.

Total Regional Capital Project Cost	**$129,336,000**
City of Vernon Portion (19%)	**24,574,000**
Annual Cost	
Debt Service (30 yrs. @ 6%)	$1,787,000
Operation and Maintenance	166,000
Power Cost (Pumping Facilities)	36,000
Water Treatment Costs ($0.75/1,000 Gals)	538,000
Water Purchase (From W.F. @ $0.21/1,000 Gals)	151,000
Total Annual Cost	**$2,678,000**
Available Water Yield (Acre-Feet Per Year)	2,200
Available Water Yield (MGD)	2
Cost of Water Delivered ($ Per Acre-Feet)	**$1,217**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$3.74**

5.3.7 Hinds-Wildcat and Lockett Water Supply Systems

As previously discussed in Section 5.3.1, Vernon provides water to five local water supply systems. Due to the levels of nitrates in Vernon's current supply and the local Seymour Aquifer, several suppliers were identified with water quality needs. Most of these needs will be resolved with no additional capital improvements when Vernon's nitrate removal system is completed. Two systems, Hinds-Wildcat and Lockett, cannot receive treated water from Vernon without the construction of a pipeline from Vernon's water treatment plant to the respective entity. Other options for these systems are limited due to their size and available resources. The primary source of water for this area is the Seymour Aquifer. Both systems currently employ a bottled water program for customers needing low nitrate water (pregnant women and babies under one year old). It is the intent of the Red River Authority of Texas, who owns and manages these water supply systems, to continue the bottled water program until such time that the required capital improvements can be completed.

Hinds-Wildcat Water System

For the Hinds-Wildcat system, it would be cost prohibitive to install an individual nitrate removal system. The smallest size system is approximately 100 gpm, which is more than twice the capacity needed. The only other alternative is a 2.5-mile, 6-inch pipeline from Vernon's treatment plant to the Hinds pump station located north of County Road 925. Vernon would then provide Hinds-Wildcat the same quantity of treated water blend (40 acre-feet per year), rather than raw water.

Quantity, Reliability and Cost

The quantity of the supply to Hinds-Wildcat is adequate for their needs and the reliability will be high after Vernon develops one of the water supply strategies. The cost of the Hinds transmission system is moderately high because the pipeline must cross the Pease River and the quantity of water is small. A summary of the costs is presented below.

Alternative Hinds-Wildcat Pipeline

Construction Costs	
6" Pipeline	$238,000
ROW Costs	24,000
Pump Stations	250,000
Road Crossings	9,000
Railroad Crossings	18,000
River Crossings	18,000
Metering Vaults	16,000
Subtotal Construction Costs	$573,000
Other Project Costs	
Mitigation & Permitting	$13,000
Engineering/ Contingencies	50,000
Interest during construction (6 month construction period)	12,000
Subtotal Other Costs	$75,000
Total Capital Project Costs	**$648,000**

Annual Costs	
Debt Service (30 years @ 6%)	$47,000
Operation and Maintenance	4,000
Pumping Costs	1,000
Treatment Costs	0
Water Purchase Costs	0
Total Annual Costs	**$52,000**
Available Water Yield (Acre-Feet Per Year)	40
Available Water Yield (MGD)	0.036
Cost of Water Delivered ($ Per Acre-Feet)	**$1,300**
Cost of Water Delivered ($Per 1,000 Gallons)	**$4.00**

<u>Environmental Factors</u>

The environmental impacts would be low because the pipeline route would generally follow existing roadways. The pipeline would have to cross the Pease River and there may be temporary environmental impacts during construction.

<u>Impacts on Water Resources and Other Water Management Strategies</u>

There should be no water resource impacts since no additional water is used from the Seymour Aquifer.

<u>Impacts on Agriculture and Natural Resource</u>

There should be no impacts on agriculture since no additional water is used from the Seymour Aquifer.

<u>Other Relevant Factors</u>

This strategy could be implemented between 2 and 5 years. The permitting and regulatory requirements are expected to be low. A 404 permit would be required for the transmission pipeline from Vernon to Hinds since it crosses the Pease River. As the pipeline routes are finalized, additional coordination with state and local agencies regarding sensitive environmental factors may be needed. An NPDES storm water permit will be required during construction. If a pipeline affects state-owned lands, additional permits and/or a Grant of Easement may be required.

Lockett Water System

Alternative L-1 Pipeline from Vernon to Lockett

Vernon currently provides Lockett approximately 2 to 10 acre-feet per year of water via a 3 or 4-inch pipeline. The remainder of Lockett's supply (approximately 100 acre-feet per year) is from local wells in the Seymour Aquifer. To provide Lockett with low-nitrate treated water to blend with Lockett's existing supply, a new 6-inch pipeline would need to be constructed from Vernon's treatment plant to Lockett's ground storage tank. Vernon would then provide an additional 60 acre-feet per year of water to Lockett. This supply will be available when Vernon develops one of the potential water supply strategies.

Quantity, Reliability and Cost

The cost for low-nitrate water to Lockett is high due to the relatively long pipeline and small amount of water. Also, the purchase price for low-nitrate water is higher than the blended supply provided to other customers. The cost per acre-foot presented below is based on the final blended supply for Lockett, not the purchase supply from Vernon. Costs to produce 40 acre-feet per year of supply from Lockett's existing well field are not included. According to Red River Authority of Texas, these costs are relatively small, ranging from $ 0.35 to $ 0.75 per 1,000 gallons.

Alternative L-1 Lockett Pipeline

Construction Costs	
6" Pipeline	$827,000
ROW Costs	84,000
Pump Station	100,000
Highway Crossings	54,000
Metering Vaults	16,000
Subtotal Construction Costs	1,081,000
Other Project Costs	
Mitigation & Permitting	$32,000
Engineering/ Contingencies	108,000
Interest During Construction (12 month construction period)	51,000
Subtotal Other Costs	$191,000
Total Capital Project Costs	**$1,272,000**

Annual Costs	
Debt Service (30 years @ 6%)	$92,000
Operation and Maintenance	13,000
Pumping Costs	700
Treatment Costs	0
Water Purchase Costs	48,000
Total Annual Costs	**$153,700**
Available Water Yield (Acre-Feet Per Year)	109
Available Water Yield (MGD)	0.10
Cost of Water Delivered ($ Per Acre-Feet)	**$1,405**
Cost of Water Delivered ($ Per 1,000 Gallons	**$4.31**

Environmental Factors

The environmental impacts would be low because the pipeline route would generally follow existing roadways.

Impacts on Water Resources and Other Water Management Strategies

There should be no water resource impacts since no additional water is used from the Seymour Aquifer.

Impacts on Agriculture and Natural Resources

Impacts to agriculture should be minimal. For the Lockett system, purchasing additional water from Vernon may increase available supply for agriculture in the vicinity of the Lockett well field.

Other Relevant Factors

This strategy could be implemented between two and five years. The permitting and regulatory requirements are expected to be low. The Lockett pipeline project may only require a nationwide 404 permit if it does not affect state-owned waters. As the pipeline route is finalized, additional coordination with state and local agencies regarding sensitive environmental factors may be needed. An NPDES storm water permit will be required during construction. If the pipeline affects state-owned lands, additional permits and/or a Grant of Easement may be required.

Alternative L-2 Nitrate Removal System

Alternatively, Lockett could install a small nitrate removal system to treat high nitrate water pumped from its existing well system. Lockett would continue to purchase a small amount of the treated blended water from Vernon to supplement its peak demands in the summer. It is assumed that a 100 gpm ion exchange treatment plant would be sufficient to treat Lockett's current supply and meet peak flows. The plant would be installed near Lockett's well field and storage tank. The waste stream from the treatment plant would be small, approximately 0.5 gpm. There are no known wastewater treatment plants near the Lockett well field. Therefore, the waste stream would discharge to a 0.25 acre evaporation pond, located near the treatment plant. Based on existing water quality data, a 60 percent treated to 40 percent untreated blend would result in nitrate concentrations below the drinking water standard.

Quantity, Reliability and Cost

The quantity of water would be sufficient to meet Lockett's needs, provided Lockett continues to supplement their peak summer demands with purchased water from Vernon. The reliability is high and the cost for a nitrate removal system is relatively low. The cost per acre-foot is based on the final blended supply for Lockett. For comparison purposes to Alternative L-1, the costs to produce supply from Lockett's existing well field are not included. According to the Red River Authority of Texas, these costs are relatively small, ranging from $ 0.35 to $ 0.75 per 1,000 gallons, which would be added directly to the cost per 1,000 gallons shown below.

Alternative L-2 Lockett Ion-Exchange System

Construction Costs	
Ion-Exchange Equipment (100 gpm)	$175,000
Building/Electrical	150,000
Evaporation Pond (.25 ac)	30,000
Land Purchase	10,000
Subtotal Construction Costs	$365,000
Other Project Costs	
Permitting	$15,000
Engineering/ Contingencies	110,000
Interest During Construction	20,000
(12 month construction period)	
Subtotal Other Costs	$145,000

Total Capital Project Costs	**$510,000**
Annual Costs	
Debt Service (30 years @ 6%)	$37,000
Operation and Maintenance	5,000
Pumping costs	0
Treatment Costs	5,000
Water Purchase Costs	0
Total Annual Costs	**$47,000**
Available Water Yield (Acre-Feet Per Yield)	109
Available Water Yield (MGD)	0.10
Cost of Water Delivered ($ Per Acre-Feet)	**$431**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$1.32**

Environmental Factors

The environmental impacts would be low because there will be no discharge of the brine wastewater stream. Also, the salt concentration of the waste stream should not be very high.

Impacts on Water Resources and Other Water Management Strategies

There should be no water resource impacts since no additional water is used from the Seymour Aquifer. The nitrate removal system improves the water quality of the supply from the Seymour Aquifer.

Impacts on Agriculture and Natural Resources

Impacts to agriculture should be low. A minimum of one acre of existing agricultural land would need to be purchased for the treatment plant and evaporation pond. No additional water would be pumped from the Seymour Aquifer. Therefore, there should be no additional impacts to agricultural supply.

Other Relevant Factors

This strategy could be implemented between two and five years. The permitting and regulatory requirements are expected to be moderate. The water treatment plant would require approval from TNRCC and the system would require a no discharge wastewater permit. An NPDES storm water permit will be required during construction. This alternative may require additional staff to maintain and operate the system. Also, the evaporation ponds may require periodic disposal of accumulated salt deposits.

5.4 City of Electra

5.4.1 Background

The City of Electra is located in Wichita County between Wichita Falls and Vernon on Highway 287. Electra has a population of 3,100 people. Approximately 60 percent of the City's drinking water is currently derived from surface water (Lake Electra). Groundwater from the Seymour Aquifer provides the remainder of the City's water supply.

With recent droughts, the City of Electra has frequently experienced a shortage of water. As of March 2000 curtailment of water usage on the City's part had been ongoing for at least 36 months and the City had implemented Stage 5 of its drought contingency plan.

In an application to the Texas Water Development Board Drinking Water State Revolving Fund, filed on behalf of the City in February 2000, it was estimated that only a six-month supply of water was left in Lake Electra, the City's main water supply source. In March, the news media placed Lake Electra at only 20 percent of capacity.

Because of Electra's recent water shortage, it has already begun taking measures to acquire water to meet its immediate and short-term needs. The long-term needs of Electra will be addressed in the following sections.

5.4.2 Water Demands

Electra provides service to approximately 1,650 connections including the Harrold Water Supply Corporation. Current normal usage (no drought restrictions enforced) averages about 0.54 MGD (605 acre-feet per year) with peaks of 0.9 MGD according to the City's consulting engineer, Donald G. Rauschuber and Associates, Inc. (DGR).

Water use projections established by the Texas Water Development Board (TWDB) show Electra's year 2000 demand to be 0.55 MGD (617 acre-feet per year). Assuming a peaking factor of two, the projected peak demand would be 1.10 MGD. The TWDB demand projections decline gradually to 609 acre-feet per year by the year 2050.

In addition to TWDB demands, water demand projections have been performed for the City by DGR. DGR projections extend to the year 2020. The DGR demands projections anticipate much more industrial and population growth for Electra than the TWDB projections. DGR projects Electra's water demand in the year 2020 at about 1,100 acre-feet per year.

For Senate Bill 1 (SB1) planning purposes, 617 acre-feet per year demand will be evaluated by the alternatives in this report. The DGR demands are given here for informational purposes. The DGR demand projections are important because the system improvements currently being undertaken by Electra will use the higher projected demand predictions in the sizing of facilities and appurtenances.

5.4.3 Current Water Resources

Lake Electra

Lake Electra is a small-to-medium-sized reservoir located approximately seven miles southwest of the City. The lake is located on land owned by the W. T. Waggoner Estate. An agreement between W. T. Waggoner Estate and the City grants rights to the water in the reservoir to the City, but the W. T. Waggoner Estate retains ownership of the land and dam that forms the lake. W. T. Waggoner Estate also pumps some water from the lake for its own use, including watering livestock and irrigating crops. Additional facilities related to this water source and owned by the City include a raw water pump station, a raw water transmission line to town, and a water treatment plant, known as the "Central Plant," located in town.

Approximately 60 percent of Electra's water is currently produced from Lake Electra. Due to its small drainage area, Lake Electra has historically been unreliable in drought conditions. Additional water sources are needed to supplement available water and improve reliability.

River Well Field

The remaining water supply for Electra is a shallow water well field located approximately eight miles north of town near the Red River. While the well field is generally an abundant source of supply, it's water quality has been a problem. Over time salinity and nitrate levels in the wells have risen. As a result, the City has been forced to shut down and cap some of the wells. Capacity of the remaining wells currently averages 220,000 gallons per day (gpd).

The City also operates a sand filter treatment plant at the well field, known as the "River Plant," and a transmission pipeline to town. The treatment plant is in place because the water pumped from the wells is considered by the TNRCC to be "groundwater under the influence of surface water" and, by regulation, must be treated. The transmission pipeline consists of two parallel 8-inch lines extending from the treatment plant to a booster pump station located midway to town. From the booster station to town, the line is a single 10-inch line.

In addition, the City maintains a water pumping lease on land near the River Plant. The lease was established to allow the City to drill wells and to pump water. However, well development has not yet taken place on the lease property.

5.4.4 Review Of Alternative Water Supply Strategies

Alternative water supply strategies were identified through consultation with Electra's engineer and the RWPG Technical Advisory Committee. Initially, eleven potential water supply options were investigated. The preliminary investigation reviewed various alternatives related to development of new groundwater supply, development of new surface water supply, and purchase of treated water. Most alternatives were eliminated in the preliminary investigation by one or more fatal flaws. Only four alternatives were found to be potentially feasible. These alternatives are discussed here in more detail. Detailed analysis of these alternatives was performed using procedures required by the TWDB.

The potentially feasible options selected for detailed analysis are shown in Figure 4 and include:

1. Redevelop existing capped wells and construct an RO plant at the River Well Field.

2. Construct a new raw water pipeline from Lake Diversion and construct RO plant at the Central Plant.

3. Buy treated water from Wichita Falls.

4. Participate in a regional water treatment plant using Lake Kemp/Lake Diversion water.

A detailed description of each potentially feasible alternative and analysis of each follows.

Alternative E-1: River Well Fields

Electra has made a commitment to meet its existing and short-term demands with a plan to redevelop the capped wells at the existing well field located north of town to increase its yield of the groundwater resource and reduce its dependence on Lake Electra. A design-build contract for this plan has been awarded, and the well field and treatment plant improvements are scheduled to go on-line in October 2000.

In addition to the existing well field to be redeveloped, the well plan includes three different potential well fields—Lalk, Sefcik, and Elliot. The fields range from 2 miles to 6 miles away from the existing treatment plant. As demand requires, new wells would be drilled at the other well field sites and water would be piped to the existing treatment plant.

The plan initially includes reopening and reworking the capped wells at the existing well field and installing a reverse osmosis (RO) treatment unit at the River Plant. A portion of the high salinity/high nitrate water will be treated with reverse osmosis and the remaining portion will be treated with the current method, sand filtration. Before entering the transmission line, the two treated streams will be blended and transmitted to town via the existing pipeline. The result will be a water that is low enough in salts and nitrates to be considered safe for drinking.

The capacity of this RO blend system will be 0.5 MGD (finished water), sufficient to meet 90 percent of Electra's average daily requirement. For the remaining demand and for peak demand, Electra will use water from Lake Electra. In the future, the well fields will be the primary supply source.

This plan requires a significant financial obligation for the City of Electra. Therefore, this "short-term" commitment is in actuality likely to be a medium-to-long-range commitment for Electra. It is expected that stages of this plan will be phased in over time as necessary to meet Electra's water needs for the next 20 years.

The phases of the current plan are as follows:

- Build RO plant at existing treatment facilities
- Rework existing capped wells
- Develop new well fields
- Build pipelines from new well fields to existing plant
- Increase capacity of RO treatment as necessary

It is expected that development of at least some new wells will be required. Initial pumping tests indicate the uncapped wells can produce enough quantity of water to meet Electra's needs, but the quality could degrade once pumping begins. The wells were originally capped because the quality had degraded after some period of pumping. As the water quality degrades, additional wells will be brought on-line to improve the quality of the feed/blend water.

Other phases of the well field alternative, could potentially take the capacity to 1.0 MGD. Other alternatives are not evaluated here because it is assumed that the projected 617 acre-feet per year demand can be satisfied using the well field and Lake Electra as described above.

Alternative E-2: Construct New Raw Water Pipeline and RO Plant

The City of Electra would purchase raw water from the City of Wichita Falls and/or Wichita County Water Improvement District No. 2 (WCWID #2) out of Lake Diversion. This alternative would involve the construction of 18 miles of new 12-inch line from Lake Diversion to Electra.

Water would be pumped to Electra and treated at a new RO plant to be constructed at the Central Plant location.

There is an existing pump platform on Lake Diversion that is owned by West Texas Utilities (WTU). It is understood that there is enough room on the existing pump platform to accommodate additional pumps, and that WTU is willing to allow Electra to purchase access to the pump platform.

Lake Diversion water is high in dissolved solids. Advanced membrane treatment, such as RO, would be required to produce drinkable water.

Alternative E-3: Buy Treated Water from Wichita Falls

This alternative consists of purchasing treated water from Wichita Falls. Wichita Falls has an existing contract to sell water to the City of Iowa Park, which is located between Electra and Wichita Falls. Electra would tap into the Wichita Falls to Iowa Park line at the Iowa Park terminus. Electra would also construct a new ground storage tank and booster station at the terminus of the existing line. In addition, 16 miles of 10-inch line would be constructed between the booster station and Electra. The pipeline route would generally follow US Highway 287.

Regional Water Treatment Plant Alternative

A regional water supply project using Lake Kemp/Diversion water with desalination could provide the City of Electra with 1 MGD of treated water. At Lake Diversion, the water would be treated by reverse-osmosis (RO), and then pumped to the City of Electra through a regional pipeline system. Further description of this alternative is presented in Section 5.6.

5.4.5 Analysis of Viable Strategies

The analysis of viable strategies was performed following the evaluation procedures identified in Section 5.1.2. The results of this evaluation are presented as follows:

Alternative E-1: River Well Fields

Quantity, Reliability, and Cost

Currently, Electra produces an average of 0.22 MGD from the river well field. After the planned uncapping of old wells and installation of an RO plant, the capacity of the well field will be increased to 0.5 MGD (approximately 90 percent of TWDB demands). Lake Electra will make up the remainder of the daily demand.

The shallow aquifer used by the City is capable of producing the required quantity of water, although the reliability of shallow aquifer yields during extreme drought conditions may be uncertain. The decreased normal use of Lake Electra should enable greater dependence on this surface water resource in dry periods.

The limiting factor for the groundwater will likely be quality. The quality is expected to degrade over time through pumping induced migration of salts increasing the required blend ratio of RO-treated to filter-treated water. This could require increasing the RO plant capacity.

Another issue affecting the reliability of the well fields is their close proximity to the Red River. The wells are actually located in the 100-year flood plain of the Red River. As such, there is some inherent danger that the wells may be temporarily unusable because of flooding. Flooding can cause damage to pumping and transmission equipment as well as potential contamination of the wells. The existing wells have an average depth of 40 feet and are hydraulically connected to surface water. Therefore, there is a potential danger that the aquifer might become contaminated through an unexpected release of pollutants.

For costing purposes, the proposed well field rehabilitation was broken into phases. Because it is expected that the uncapped wells will rapidly degrade in the first five years, development of one of the three future well fields was included in Phase 1. The first phase involves reworking the existing capped wells, drilling new wells at the Lalk well field, constructing a pipeline from the new well field to the River Plant, and constructing an RO plant. A summary of the capital and annual costs are presented below.

Alternative E-1 Redevelop River Well Fields

Construction Costs	
Water Wells	$168,000
Ground Storage/Pump Station	100,000
8" Water Line from Wells to River Plant	344,000
RO Treatment Plant	726,000
Brine Disposal	213,000
Subtotal Construction Costs	$1,551,000
Other Project Costs	
Engineering, Contingencies and Legal Services	$542,000
Easement Costs	121,000
Environmental and Archeological Studies, Mitigation, and Permitting	15,000
Interest During Construction (18 Months)	128,000
Subtotal Other Costs	$806,000
Total Capital Project Costs	**$2,357,000**
Annual Costs	
Debt Service (30 yrs. @ 6%))	$171,000
Operation and Maintenance	164,000
Power Costs	12,000
Lake Electra Plant O&M	25,000
Total Annual Costs	**$372,000**
Available Water Yield (Acre-Feet Per Year)	617
Available Water Yield (MGD)	0.56
Annual Cost of Water Delivered ($ Per Acre-Feet)	**$604**
Annual Cost of Water Delivered ($ Per 1,000 Gallons)	**$1.85**

This alternative includes 560 acre-feet per year from groundwater, which is less than the 617 acre-feet per year projected as demand. The additional 57 acre-feet per year will be made up by Lake Electra water, which the City already has infrastructure in place. To account for this, an annual operations and maintenance cost to keep the Central Plant operating was included in the cost opinion. Costs for treating the additional Lake Electra water are therefore reflected in the unit cost of water for this option.

Environmental Impacts

Environmental impacts of the proposed well field rehabilitation center mainly on disposal of the residual salt brine from the RO treatment process. The method of disposal has not yet been decided, although the City is currently negotiating with the TNRCC for a surface water discharge permit to the Red River. Other options for disposal investigated include evaporative ponds, deep well injection, and surface application.

Discharge to the Red River is the City's preferred disposal alternative. A discharge of this sort will likely require acceptance by both the TNRCC and the Oklahoma Department of Environmental Quality (ODEQ) since the south bank of the Red River is the state boundary.

Impacts on Water Resources and Water Management Strategies

The major potential water resources impacts would come through disposal of the salt brine. As mentioned in the Environmental Impacts Section, the disposal options available are direct discharge to the Red River, deep well injection, evaporative ponds, or land application.

Other impacts that might be associated with the well field are a lower aquifer level and quality degradation in the vicinity of the well fields. Also, since the aquifer is hydraulically connected to the Red River, subsurface flow to the Red River may be decreased near the wells.

Electra's acute short-term need for additional water has forced the implementation of the initial stages of this alternative. As such, it is likely that this alternative will become the preferred alternative to the City, simply due to the significant investment required. Other potentially feasible alternatives, including participation in any regional alternative, will likely become less attractive to the City.

Impacts on Agriculture and Natural Resources

Agricultural impacts should be minimal. A declining aquifer level and degradation of the aquifer in the vicinity of the well field could potentially impact local irrigation, if such irrigation is practiced. This alternative should not impact natural resources of Texas.

Other Relevant Factors

The long-term viability of this alternative may depend on the success of development of new shallow well fields. Since tests in all other potential well fields have not been completed, the ultimate capacity and water quality of these future fields are not known. In addition, the City's own projections for future water use exceed those of the TWDB. Should this become a reality, the City may eventually desire to implement other potentially feasible alternatives.

Alternative E-2: New Pipeline from Lake Diversion/Advanced Treatment at Central Plant

Quantity, Reliability, and Cost

Assuming Wichita Falls and/or WCWID #2 will sell the water, Lake Diversion can provide 100 percent of Electra's demand to the year 2050. Lake Diversion could be considered a reliable source of water because it is located downstream of the larger Lake Kemp, which is also owned and controlled by the City of Wichita Falls and WCWID #2. Lake Kemp has the largest yield of any lake in the region and would be needed to support Lake Diversion. A summary of the estimated cost of this alternative follows:

Alternative E-2 Buy Raw Water from Wichita Falls at Lake Diversion

Construction Costs	
0.5 MGD Pumps at Lake Diversion	$71,000
12" Raw Water Line (Lake Diversion to Electra)	2,821,000
RO Treatment Plant	766,000
Brine Disposal	184,000
Subtotal Construction Costs	$3,842,000
Other Project Costs	
Engineering, Contingencies and Legal Services	$1,344,000
Easement Costs	371,000
Environmental and Archaeological Studies, Mitigation, and Permitting	15,000
Interest During Construction (24 Months)	436,000
Subtotal Other Costs	$2,166,000
Total Capital Project Costs	**$6,008,000**
Annual Costs	
Debt Service (30 yrs @ 6%)	$436,000

Operation and Maintenance (Including Pipeline, Pump Station, and Treatment Plant)	146,000
Power Costs	16,000
Purchased Water Cost	66,000
Total Annual Costs	**$664,000**
Available Water Yield (Acre-Feet Per Year)	617
Available Water Yield (MGD)	0.56
Cost of Water Delivered ($ Per Acre-Feet)	**$1,076**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$3.97**

Environmental Impacts

Environmental impacts from the pipeline would be minimal. The preferred route would be primarily along the Highway 25 right-of-way and would likely involve only one major creek crossing. The most critical potential environmental impact is the disposal of the RO brine from the treatment process. The City's consultant had evaluated this alternative on the assumption of using evaporation ponds for brine disposal. While this is technically feasible, disposal of liquids in this manner will require careful monitoring of the operation to prevent accidental releases of highly saline wastewater.

Impacts on Water Resources and Water Management Strategies

Water resource impacts should be minimal. A pump platform/intake structure is already in place at Lake Diversion, minimizing additional impacts from construction within the body of the lake. Should Electra pursue this alternative, its participation in any regional strategy would be unlikely.

Impacts on Agriculture and Natural Resources

Agricultural impacts should be very minimal. As mentioned previously, the preferred pipeline route would be along existing road right-of-way. Lake Diversion is an existing reservoir, so the amount of agricultural land disturbed would be minimal.

Other Relevant Factors

No other relevant factors regarding this alternative have been identified at this time.

Alternative E-3: Buy Treated Water from Wichita Falls

Quantity, Reliability, and Cost

This alternative would likely provide for all of Electra's water demand, provided Wichita Falls has the water to sell. For comparison purposes, it was assumed that Wichita Falls will have sufficient supply of water to enter into a contractual agreement with Electra to provide the necessary treated water. It was also assumed that the treated water would be provided to Electra at $0.95 per 1,000 gallons.

Reliability of this alternative system should be good. Because the water would be sold by contract, Wichita Falls would be obligated to provide the water to Electra. The only maintenance requirement would be on the booster pump station and the Iowa Park to Electra line. A summary of the cost of this alternative follows:

Alternative E-3 Buy Treated Water from Wichita Falls at Iowa Park

Construction Costs	
Ground Storage/Booster Pump Station	$105,000
12" Treated Water Line from Iowa Park to Electra	2,575,000
Subtotal Construction Costs	2,680,000
Other Project Costs	
Engineering, Contingencies and Legal Services	$938,000
Easement Costs	280,000
Environmental and Archaeological Studies, Mitigation, and Permitting	15,000
Interest During Construction (12 Months)	163,000
Subtotal Other Costs	$1,396,000
Total Capital Project Costs	**$4,076,000**
Annual Costs	
Debt Service (30 yrs @ 6%)	$296,000
Operation and Maintenance	50,000
Power Costs	13,000
Purchased Water Cost	173,000
Total Annual Costs	**$532,000**
Available Water Yield (Acre-Feet Per Year)	617
Available Water Yield (MGD)	0.56

Cost of Water Delivered ($ Per Acre-Feet)	**$863**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.65**

Environmental Impacts

Environmental impacts should be minimal since the pipeline route would generally follow Highway 287. There will likely be some creek crossings along the pipeline route, but there are no major issues that are readily apparent at this level of study.

Impacts on Water Resources and Water Management Strategies

The impacts to other resources and strategies involved with this option would be indirect. In order for Wichita Falls to provide the water to Electra, it must first have the water to sell. That means Wichita Falls will potentially have to develop new sources of water prior to entering into a contract with Electra. Therefore, the timing of such a project would likely be dependant on the development of Wichita Falls' own alternatives.

Impacts on Agriculture and Natural Resources

Because the pipeline route would follow the highway alignment, it is not expected that agriculture or natural resources would be significantly impacted.

Other Relevant Factors

No other relevant factors regarding this alternative have been identified at this time.

Regional Water Treatment Plant Alternative

This alternative is based on the City of Wichita Falls, City of Vernon, and the City of Electra participating in a regional plan to utilize Lake Kemp/Diversion and construct a desalination plant at the reservoir site.

Annual Cost - City of Electra	
Debt Service (30yrs @ 6%)	$658,000
Operation and Maintenance	41,000
Power Costs (Pumping Facilities)	15,000
Water Treatment Costs ($0.75/1,000gal)	269,000
Raw Water Purchase (From W.F.@0.21/1,000gal)	75,000

Total Annual Cost	**$1,058,000**
Available Water Yield (Acre-Feet Per Year)	1100
Available Water Yield (MGD)	1
Cost of Water Delivered ($ Per Acre-Feet)	**$962**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.95**

5.5 Thalia Water Supply Corporation

In Chapter 4, Thalia WSC was listed as deficient in water supply due to water quality. The specific parameter of concern was the concentration of nitrate in the water source. Thalia WSC has historically utilized the Seymour Aquifer to supply 100 percent of its water.

In 1997, the Thalia WSC applied to the TWDB Drinking Water State Revolving Fund for assistance with a project to reduce nitrate concentrations in their drinking water to acceptable levels. The project was planned to construct a water line from the City of Crowell to Thalia WSC to enable the purchase of water for blending purposes. According to the City of Crowell, a water line has been constructed and the City is selling water to Thalia WSC at this time. Sufficient water exists from Crowell's supplier, Greenbelt Municipal & Industrial Water Authority to provide Thalia WSC with all its water demand, if desired.

Recent water quality data from Thalia WSC suggest that nitrate levels in the distribution system have dropped substantially. It is presumed that this is a result of the purchase of sufficient water from Crowell to accomplish an adequate blend. At this time, Thalia WSC is still officially on the TNRCC list of MCL violators for nitrate. However, as recent data indicate, Thalia WSC now has the capability to eliminate this problem. Therefore, an analysis of water management alternatives for Thalia WSC is not necessary.

5.6 Regional Water Treatment Plant Alternative (Lake Kemp/Diversion Reservoirs)

5.6.1 Background

As indicated in the previous discussions of alternatives, the feasibility of meeting demand through participation in a regional water treatment plant has been investigated. The feasibility of such an alternative is dependent on having wide participation of the region’s water suppliers.

For purposes of this analysis, the participation of those water suppliers with identified needs -- Wichita Falls, Vernon, and Electra -- has been assumed.

5.6.2 Water Demands

For the regional plan, it was assumed that the maximum yield from the Lake Kemp/Lake Diversion system would be used for sizing the plant. The maximum raw water allocation of the Kemp/Diversion reservoirs for municipal use is 25,150 acre-feet per year. Substantial water rights allocations also exist for agriculture, mining, and industrial purposes.

Lake Kemp/Diversion waters are naturally high in chloride, sulfates, and total dissolved solids. Reducing these constituents to acceptable levels will require advanced membrane technology, specifically, reverse osmosis (RO). Prior to RO treatment, microfiltration (MF) will be used. Assuming a 70 percent recovery rate for MF/RO treatment, the total finished water available would be 17,600 acre-feet per year.

Allocation of the treated water for the three participating water suppliers was assumed as follows:

City of Electra	1,100 acre-feet per year
City of Vernon	2,200 acre-feet per year
City of Wichita Falls	14,300 acre-feet per year

5.6.3 Facilities Description

The regional water system is depicted in Figure 5. The facilities consist of a raw water intake structure and pump station located at Lake Diversion. Raw water would be pumped to the 16 MGD treatment plant. Treated water from the MF/RO plant would be stored in the clearwell and then pumped via a 42-inch line constructed to Kadane Corner, east of Lake Diversion. At Kadane Corner the 42-inch transmission line proceeds eastward to Wichita Falls existing Cypress Water Treatment Plant. A 24-inch diameter line would also take a portion of the water at Kadane Corner north to Electra, carrying treated water for both Vernon and Electra. At Electra, the line will be reduced to an 18-inch line, which will turn northwestward along Highway 287 to Vernon. The City of Electra will receive treated water at its Central Plant from the 24-inch water line. Two booster stations are needed for the Vernon/Electra line. One will be located approximately halfway between Kadane Corner and Electra on the 24-inch line. The other will be located about halfway between Electra and Vernon.

Cost allocations will be established by each participant's allocation of water as well as amount and size of pipeline required for each. The resulting cost allocation for capital costs is as follows:

City of Wichita Falls	74%
City of Vernon	19%
City of Electra	7%

Each entity would be responsible for the cost of delivery of its share of the treated water to its customers.

Quantity, Reliability, and Cost

The quantity of water provided by the regional treatment plant would be greater than the TWDB demand for each city. Electra would receive 1,100 acre-feet per year, Vernon 2,200 acre-feet per year, and Wichita Falls 14,300 acre-feet per year.

Current reliability of the Kemp/Diversion system is moderate to high. Lake Kemp has the highest yield of any reservoir in the region, so meeting water demands with Kemp/Diversion water should not be an issue. However, as the reservoir ages, sedimentation will likely reduce the yield and may pose reliability problems in the future. Future reliability of Lake Kemp, beyond 2050, could be classified as moderate to low.

The cost breakdown of the proposed regional treatment plant is as follows:

Regional Water Treatment Plant Alternative

Construction Costs	
16 MGD Pump Station Near Diversion	$2,500,000
3 MGD Pump Station Near Electra	900,000
2 MGD Pump Station Near Vernon	750,000
Lake Intake Structure	3,500,000
16 MGD Microfiltration/Reverse Osmosis Treatment	36,000,000
Treatment Brine Reject Disposal	3,000,000
42" Treated Water Line (To Kadane) (7 Miles)	8,100,000
42" Treated Water Line (Kadane To W.F.) (17.5 Miles)	20,925,000
24" Treated Water Line (Kadane to Electra) (16 Miles)	7,183,000
18" Treated Water Line (Electra to Vernon) (21 Miles)	6,660,000
Subtotal Construction Costs	$89,518,000
Engineering, Legal, Financial & Contingencies	$29,188,000
Land and Easements	750,000
Environmental Studies, Mitigation, and Permitting	500,000
Interest During Construction (24 months)	9,380,000
Subtotal Other Costs	$39,818,000
Total Capital Project Costs	**$129,336,000**

Allocate Project Cost of Regional System Based On Pro-Rata Design For Each Entity As Follows:

City of Wichita Falls	74% of Cost
City of Vernon	19% of Cost
City of Electra	7% of Cost
Allocated Total Capital Project Costs:	
City of Wichita Falls	$95,709,000
City of Vernon	$24,574,000
City of Electra	$9,053,000
Annual Costs - City of Wichita Falls:	
Debt Service (30yrs @ 6%)	$6,958,000
Operation and Maintenance	325,000
Power Costs (Pumping Facilities)	75,000
Water Treatment Costs ($0.75/1,000gals)	3,494,000
Total Annual Cost – City of Wichita Falls	**$10,852,000**
Available Water Yield (Acre-Feet Per Year)	14,300
Available Water Yield (MGD)	13
Cost of Water Delivered ($ Per Acre-Feet)	**$759**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.33**

Annual Costs - City of Vernon	
Debt Service (30yrs @ 6%)	$1,787,000
Operations and Maintenance	166,000
Power Costs (Pumping Facilities)	36,000
Water Treatment Costs ($0.75/1,000gals)	538,000
Raw Water Purchase (From W.F. @ 0.21/ 1,000 gals)	151,000
Total Annual Cost – City of Vernon	**$2,678,000**
Available Water Yield (Acre-Feet Per Year)	2,200
Available Water Yield (MGD)	2
Cost of Water Delivered ($ Per Acre-Feet)	**$1,217**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$3.74**

Annual Cost - City of Electra	
Debt Service (30yrs @ 6%)	$658,000
Operation and Maintenance	41,000
Power Costs (Pumping Facilities)	15,000
Water Treatment Costs ($0.75/1,000gals)	269,000
Raw Water Purchase (From W.F. @ $0.21/1,000 gals)	75,000
Total Annual Cost – City of Electra	**$1,058,000**
Available Water Yield (Acre-Feet Per Year)	1,100
Available Water Yield (MGD)	1
Cost of Water Delivered ($ Per Acre-Feet)	**$962**
Cost of Water Delivered ($ Per 1,000 Gallons)	**$2.95**

Environmental Impacts

The environmental impacts due to the pipeline construction should be low to moderate depending on the final route of the pipelines. The ground storage facility and booster stations required along the routes can be located in areas of minimal environmental impact.

Disposal of brine reject from the RO treatment plant will likely be the most significant environmental factor. The preferred disposal option would be to discharge brine reject water into the Wichita River below the water treatment plant. Other options include evaporation ponds and injection wells.

Impacts on Water Resources and Other Water Management Strategies

There may be low to moderate water resources impacts as more of the Lake Kemp/Diversion system's yield is used. Water levels in the lakes may have greater fluctuations and this may affect recreational users, local property owners and/or businesses on the lake. This alternative is a regional strategy that is feasible only if several users support its development. If one of the cities chooses another strategy for water supply, it is unlikely that this alternative will be cost effective. Also, if Wichita Falls proceeds with developing a reverse osmosis treatment system at the existing Cypress Water Treatment Plant to treat Lake Kemp water (see WF-2), there would not be sufficient additional municipal supply at Lake Kemp.

Impacts on Agriculture and Natural Resources

The impact on agricultural lands should be low. The amount of water available for irrigation may be reduced as water from Lake Kemp is used for municipal supply. Lakes Kemp and Diversion are existing and therefore will not require impoundment of additional acreage.

Other Relevant Factors

One of the items discussed in Section 5.1 regarding review of alternatives addressed interbasin transfers. Interbasin transfer could be possible if additional entities other than Electra, Vernon, and Wichita Falls are allowed to and elect to participate. With the scenario given here, however, with only the three mentioned entities participating, no interbasin transfer will result. All source waters, users, and waste discharges are located within the Red River Basin.

This strategy could be implemented between five and ten years. The permitting and regulatory requirements are expected to be low to moderate. A 404 permit would be required for the transmission pipelines. As the pipeline routes are finalized, additional coordination with state and local agencies regarding sensitive environmental factors may be needed. If the pipeline affects state-owned lands, additional permits and/or a Grant of Easement may be required.

5.7 Chloride Control Project

The concentration of dissolved salts, particularly chloride, in some surface waters in Region B limits the use of these waters for municipal, industrial, and agricultural purposes. The Red River

Authority of Texas is the local sponsor and has been working in cooperation with the U.S. Army Corps of Engineers (USACE) for a number of years on a project to reduce the chloride concentration of waters in the Red River Basin. The successful completion of this project would result in an increase in the volume of water available for municipal and industrial purposes in Region B and water would be available for a broader range of agricultural activities. Therefore, the Chloride Control Project (CCP) is included in the Regional Water Plan as one of the feasible strategies for meeting the water supply needed in Region B. Following is a summary of the CCP that presents the background of the project, the components, and current status of the project, and an analysis of the CCP as a regional water resource strategy.

5.7.1 Background

In 1957 the U.S. Public Health Service initiated a study to locate the natural sources that contribute high concentrations of chloride to surface waters in the Red River Basin. It was determined that ten natural salt source areas in the basin contribute approximately 3,300 tons of chloride each day to the Red River.

In 1959 the USACE performed a study to identify control measures for these salt sources. Subsequently, structural measures were recommended for eight source areas.

5.7.2 Description of the Chloride Control Project

The primary strategy for reducing the flow of highly saline waters to the Red River is to impound these flows behind low dams and pump the saline waters to off-channel brine reservoirs where the water evaporates or is disposed of by deep-well injection. During high-flow periods, when the chloride concentration is lower, waters flow over the low dams and proceed downstream. Figure 6 identifies the locations of the eight saline inflow areas, the existing and proposed low-flow dams, and the existing and proposed brine reservoirs.

There are four saline inflow areas that impact water quality in Region B:

- Areas VII, VIII, and X affect the quality of water in the Wichita River including Lake Kemp and Lake Diversion.

- Area IX affects the quality of waters in the Pease River, including the proposed Pease River Reservoir.

Construction of the chloride control facilities at Area VIII on the South Fork of the Wichita River in King County and Knox County was authorized in 1974. These facilities include a low dam near Guthrie, Texas, with a deflatable weir to collect the saline inflows; the Truscott Brine Reservoir near Truscott, Texas; and, a pump station and pipeline to transport the saline water from the impoundment at Guthrie to the Truscott Brine Reservoir. These facilities have been in operation since May 1987. Construction of the facilities at Area X was initiated in 1991, but they have not been completed due to a decision to modify the design of these facilities, a change to the project area, and a need to address environmental issues identified by the U.S. Fish and Wildlife Service (USFWS) and the Texas Parks and Wildlife Department (TPWD). An Environmental Impact Statement (EIS) was prepared for the project and published in 1977. A supplement to the EIS is being prepared currently that describes the proposed changes in the design of the facilities and addresses the issues raised by USFWS. Public hearings on the Supplemental Final Environmental Impact Statement (SFEIS) may be held in 2001. When the SFEIS is approved, work will proceed on the CCP facilities at Area X and Area VII.

The effectiveness and environmental impacts of the project will be evaluated as the CCP facilities are fully installed within the Wichita River Basin. The results of this evaluation will be used to determine if and, if so, how CCP facilities will be provided for Area IX on the Pease River. The proposed Pease River Reservoir would not be viable for a municipal water supply without completion of the CCP for the Pease River Basin.

5.7.3 Analysis of Strategy

Because of the substantial volume of good quality water that will be available as a result of implementation of the CCP, it has been identified as a feasible supply alternative for Region B. Accordingly, following is an evaluation of the quantity and quality of water that would be provided; the reliability of the supply; the cost to provide the water; potential impacts on the environment and agriculture in the area; the regulatory and political acceptability of, and public support for, the project; and the extent to which this strategy could affect other strategies.

This is not a stand-alone alternative. Rather, it is a variation of the other alternatives that include the use of Lake Kemp/Diversion waters. The CCP is a component of a regional alternative in which the requirement for membrane treatment of municipal supplies to remove salts is replaced by source control for the salt being introduced to the Lake Kemp/Diversion systems.

However, the benefits of this alternative are not restricted solely to the elimination of the cost of membrane treatment (which is certainly beneficial because it may increase the feasibility of providing Lake Kemp/Diversion waters to some of the smaller communities). In addition, it minimizes or eliminates the problems and potential adverse environmental impacts of disposal of the brine waste stream from membrane treatment, provides economic benefits to the agricultural and industrial sectors of the economy, and extends water supplies for steam electric power generation. These benefits are discussed in more detail later in this section.

<u>Quantity, Reliability, and Cost</u>

The Wichita Basin phase of the CCP that is currently being implemented will increase water resources in the Wichita River Basin and is addressed in this initial regional plan. When the scheduling for the Pease River Basin phase of the project is more certain, the regional plan should be amended to include an evaluation of the effects of the Pease River phase of the project on water resources in Region B.

The water supply source that will be enhanced by the Wichita Basin CCP is the Lake Kemp/Diversion system. As previously described in Chapter 3 of the Region B Water Plan, the firm yield of this system is estimated at 126,000 acre-feet per year in 2000, 116,080 acre-feet per year in 2020, and 101,540 acre-feet per year in 2050. The decrease in yield is attributable to sedimentation.

Waters from the Lake Kemp/Diversion system can be used for municipal purposes and agricultural irrigation pursuant to existing water rights. By contract, waters from the system can be used for steam generation of electricity and mining purposes. The waters are also used for recreation.

The total volume of water permitted for use from Lake Kemp/Diversion, and which can be provided in most non-drought years, is 193,000 acre-feet per year. Of this permitted amount, 90,150 acre-feet per year are not being used currently.

A significant barrier to the further use of Lake Kemp/Diversion water is the quality of the water. The water quality improvement that would occur as a result of the CCP would make this water suitable for a wider variety of uses, including municipal use that does not require membrane treatment, and more diverse agricultural use.

The CCP strategy alternative has been evaluated to determine yield and cost using the methods specified by the TWDB for the regional planning process. Significant features of these evaluation methods, as they apply to the CCP, are as follows:

- The yield is based on the amount of water available during critical drought conditions.
- The storage volume of the reservoirs will decrease over time as a result of sedimentation.
- The volume of water being used by existing irrigators is expected to decrease over time as a result of the use of water conservation measures. However, as the quality improves, the quantity utilized for irrigation of additional acreage within the existing irrigation district may increase.

It was also assumed that the full benefit of the CCP may not be realized until the year 2020, in accordance with the EIS for the CCP, which was prepared in 1976 [1]

The EIS projected that the salt content in Lake Kemp would decrease over time after project completion. The projected concentrations that would not be exceeded 98 percent of the time are as follows:

Time	**Chloride mg/L**	**Sulfate mg/L**	**TDS mg/L**
Pre-project	1,300	810	3,520
Five years after implementation	350	450	1,520
Twenty years after implementation	250	320	1,080

These estimates are based on the assumption that the CCP will control 80 to 85 percent of the chloride load from Areas VII, VIII, and X.

Studies by the U.S. Geological Survey and others [2] have evaluated the effectiveness of the Area VIII control structure (which was completed in 1987). These studies confirm that the Area VIII CCP removes approximately 80 percent of the chloride load introduced by Area VIII sources. Accordingly, the average chloride concentration in Lake Kemp has decreased to approximately 1,000 milligrams per liter (mg/L). Since current studies tend to confirm the general reliability of the 1976 projections regarding the effectiveness of salt removal, it appears that within 20 years

[1] Department of the Army Corps of Engineers, Tulsa District, Final Environmental Statement; Arkansas-Red River Basin; Chloride Control; Texas, Oklahoma, and Kansas (Red River Basin), July 1976, Tulsa, Oklahoma.

[2] Red River Authority and Alan Plummer Associates, Inc., Wichita River Basin, Chloride Monitoring Data Review, November 1997, Wichita Falls, Texas.

after the completion of the CCP for Areas X and VII, it may no longer be necessary to remove chlorides from waters withdrawn from Lake Kemp/Diversion for municipal supply by demineralization.

More water will be available for municipal use as a result of the CCP. At the present time, small amounts of water from Lake Kemp/Diversion can be used to extend other available supplies. However, the percentage of Lake Kemp/Diversion water in the blend must be kept low to control the final salt content of the blended water. More Lake Kemp/Diversion water can be used for municipal supply if it is treated using a membrane treatment process. However, there are substantial losses of water associated with membrane treatment. As indicated in the discussion of the regional water treatment plant alternative (Section 5.6), of the total water volume permitted and available for municipal use (25,150 acre-feet per year), only 17,600 acre-feet per year would be produced as drinking water. This loss of approximately 30 percent is due primarily to the membrane treatment process.

In accordance with the preceding discussion, the yield of the CCP is estimated to be the amount of water that will be available from Lake Kemp/Diversion in the year 2020 that is not currently being used for agricultural or industrial purposes. This yield is 31,080 acre-feet per year.

The cost of the CCP strategy calculated according to Senate Bill 1 procedures, is summarized as follows:

Construction Costs	
Raise Truscott Brine Reservoir Dam	$ 21,763,000
Construct North Fork Wichita River Dam	19,900,000
Construct Pipeline from Middle Fork Wichita River to Truscott Brine Reservoir (14 miles)	3,721,000
Replace Pipeline from South Fork Wichita River to Truscott Brine Reservoir (22 miles)	8,986,000
Subtotal Construction Cost	$ 54,370,000
Other Project Costs	
Engineering, Legal, Financial, and Contingencies	16,311,000
Land and Easements	432,000
Environmental Studies, Mitigation, Permitting	200,000
Interest During Construction (24 months)	6,187,000
Subtotal Other Costs	23,130,000

Total Capital Project Costs	**$ 77,500,000**
Annual Costs	
Debt Service (40 years @ 6%)	$ 5,154,000
Operation and Maintenance	675,000
Power Costs	160,000
Total Annual Costs	**$ 5,989,000**
Available Water Yield (Acre-feet per Year)	31,080
Available Water Yield (MGD)	32.2
Cost of Water Delivered ($ per Acre-Foot)	193
Cost of Water Delivered ($ per 1,000 gallons)	0.59

This cost has been calculated on the additional supply available during drought conditions (31,080 acre-feet per year) rather than the currently non-used permitted amount (90,150 acre-feet per year). When calculated on this basis, the cost of water provided by the CCP is $0.59 per 1,000 gallons in the year 2020. This additional cost would be at least partially offset by the lessened treatment requirements to remove chlorides at a water treatment plant. Additionally, the effective output of the water treatment plant would be increased since there would be less brine reject from the RO treatment process.

It should also be noted that the cost impacts of the CCP on residents of Region B and the State of Texas are different than the cost impacts of membrane treatment or other supply strategies. The capital costs of the CCP facilities will be funded with federal monies. The full capital costs of membrane treatment will be funded by local users.

In addition, there are other economic benefits to the region and further value added to the water resources of the region because the quality improvement associated with the CCP will result in more efficient utilization of water. Improvement of the quality of the water will make it feasible for irrigators to grow a wider range of crops. At the present time, only crops with a high salt tolerance can be irrigated with water from Lake Kemp/Diversion. Being able to irrigate a wider range of crops can allow the irrigators to grow crops of higher value.

The CCP will also provide benefits to the industrial sector of the economy and have a positive effect on water supplies for steam power generation because it will reduce the water demand.

The concentration of TDS in a water supply limits the number of times the water can be cycled through the cooling system. If the TDS concentration is decreased, the number of cooling cycles can be increased. Subsequently, the blow-down volume will decrease, so the volume of make-up water will decrease.

The water supply produced by the CCP would be of high reliability. However, the ability of the Lake Kemp/Diversion system to deliver the full volume of water authorized by existing water rights during drought conditions is questionable because the sum of authorized water rights for all uses exceeds the firm yield of the Lake Kemp/Diversion system. Therefore, in times of drought, appropriate adjustments may be required if all users wish to take their fully authorized amount. However, a significant volume of water will be reliably available for each of the authorized uses if the CCP is implemented.

This alternative provides an additional quantity of water that has a quality suitable for a wide variety of municipal, industrial, agricultural, and steam electric purposes. The resultant water supply is projected to achieve the EPA secondary criteria for drinking water 94 to 98 percent of the time.

Environmental Factors

As previously noted, an EIS for the project was published in 1977. At the time the EIS was published, the project had the concurrence of all natural resource agencies.

During the development of the project, improved methods of brine collection and disposal were identified, and design changes were proposed. In 1994, notice was published of the intent of the USACE to prepare a supplement to the EIS that would address these changes. A draft of Supplement I to the EIS was published May 1995. During the period between 1977 and 1994, the natural resource agencies changed their position and identified a number of concerns regarding the CCP. Therefore, completion of the SFEIS has been delayed to allow further studies to evaluate these concerns. The publication of an SFEIS is now scheduled for November 2000. The remaining components of the Wichita River Basin CCP will not be completed until after the publication of the SFEIS.

Monitoring to evaluate the environmental issues that have been raised will continue after construction of the remaining CCP facilities in the Wichita River Basin in order to determine if the preconstruction assessments are valid. If significant adverse impacts attributable to the CCP are not identified, consideration will be given to proceeding with the Pease River Basin CCP facilities.

The environmental issues that have been identified are summarized below:

- Selenium (Se) is a naturally occurring element in soils in the western United States. Se in trace amounts is an essential dietary component. However, it has been concluded that, in higher concentrations, Se adversely impacts waterfowl in some areas of the country. Concern has been expressed that the concentration of Se in the brine disposal reservoirs will increase due to evaporation and pose a threat to local and migratory birds, fish, and wildlife.

- Small decreases in flows are projected to occur in the Wichita River and the Red River between the Wichita River confluence and Lake Texoma. These flow decreases will result from the diversion of low flows to the brine disposal reservoirs and increased use of the river flow for irrigation when the quality improves. Changes in water quality and quantity could impact the composition of vegetation along these river reaches and result in vegetative encroachment on the stream channel. There is a concern that decreased flows and changes in vegetative composition will adversely affect the habitat for aquatic life, birds, and wildlife.

- There is a concern that wetlands in the Red River flood plain will be adversely impacted as a result of both changes in the hydrologic regime and the conversion of land adjacent to the river to cropland and pasture.

- Concern has been expressed that the reduction in the TDS concentration in Lake Texoma, associated changes in physical characteristics of the lake (turbidity), a decrease in primary production rates due to a decrease in the depth of the eutrophic zone, and alterations in nutrient cycling will reduce the sport fish harvest in the lake and may affect the aesthetic quality of the lake.

Supplement I to the SFEIS addresses most of these issues and concludes there will not be significant impacts in most cases. Where potential impacts have been identified, mitigation measures are proposed. These issues will be evaluated further when the SFEIS is issued late in 2000.

Several state and federally listed threatened and endangered species are present in, or migrate through, the project area. To address concerns related to the bald eagle, whooping crane, and least tern, in 1994 the USFWS and USACE agreed upon a Biological Opinion that defines Reasonable and Prudent Measures to protect these species. These measures are described in Supplement I to the SFEIS.

Impacts on Water Resources and Other Water Management Strategies

Some of the other alternative strategies would provide Lake Kemp/Diversion water to the communities of Wichita Falls, Electra, and/or Vernon. In the absence of the CCP, these alternatives require treatment of Lake Kemp/Diversion water using membrane technology. Successful implementation of the CCP will ultimately reduce treatment costs for any alternative that utilizes Lake Kemp/Diversion as a water source by 1) reducing the amount of treatment needed to produce high quality drinking water; and, 2) increasing the ratio of produced water to raw water. This could significantly affect the feasibility of some alternatives in a more positive manner.

Impacts on Agriculture and Natural Resources

The impacts on agriculture associated with the CCP are positive. The improvements in the quality of water will allow the water to be used to irrigate a wider variety of crops and reduce the potential for salt build-up in soils.

Other Relevant Factors

The regulatory issue to be addressed is the issuance and approval of the SFEIS. This is scheduled to be accomplished near the end of the year 2000.

The political acceptability of the project varies depending on the sector of the community. Municipalities, industries, and the agricultural community are supportive of the project. The degree of support for the project is evidenced by the congressional approval and funding of the project in bills enacted in 1962, 1966, 1970, 1974, 1976, and 1986. In 1988, a special panel created by the Water Resource Development Act of 1986 issued a report favorable to the project. The natural resource agencies, Lake Texoma sport fishermen, and related lake businesses have expressed opposition of the project. However, substantial progress has been made in addressing the natural resource and fishing concerns. It appears probable that the Wichita River Basin portion of the CCP will proceed following completion of the SFEIS.

5.8 Recommended Water Management Strategies

Based on a comparison of the total regional water supply to demand as performed in Chapter 4, it was determined that there is adequate water supply to meet the needs of Region B as a whole through the year 2050.

However, water supply needs were identified for the City of Wichita Falls, City of Vernon, Hinds-Wildcat and Lockett Water Supply Systems, and the City of Electra. For each of these water user groups various alternatives were analyzed and evaluated as documented in this chapter. Though all the strategies may be viable options and should be considered by each entity, the following described alternatives are recommended as the preferred water management strategy for each entity listed below, and are shown in Figure 7.

City of Wichita Falls

The City of Wichita Falls has four viable water supply strategies. Two of the strategies involve utilizing existing water rights on Lake Kemp/Diversion, a third involves wastewater reuse, and the fourth requires the construction of a new reservoir site. Having evaluated each strategy and in coordination with the City of Wichita Falls, the recommended preferred strategy is Alternative WF-2: Water from Lake Kemp/Diversion Reservoirs, in tandem with Alternative WF-1: Wastewater Reuse. The combination of these two strategies will provide the additional water supply necessary to maintain existing reservoir levels above the emergency drought trigger condition.

City of Vernon

The City of Vernon has four viable water supply strategies. Three of these strategies involve purchasing water from Wichita Falls' existing water supply sources, and one expands the use of groundwater from the Seymour Aquifer. Having evaluated each strategy and in coordination with the City of Vernon, the recommended preferred strategy is Alternative V-3: Round Timber Well Field or equivalent new well field. This alternative provides sufficient supply to meet the City's growing needs and the water source complements Vernon's existing system.

Hinds-Wildcat System

The only strategy evaluated for the Hinds-Wildcat System, and therefore the recommended strategy is to install a pipeline from Vernon to the existing Hinds pump station. This alternative would provide sufficient water, however the cost will be significantly higher than the current supply.

Lockett System

Two viable strategies were evaluated for the Lockett System. One involved constructing a pipeline from the City of Vernon and the other involved constructing a small ion exchange water treatment system to treat Lockett's existing supply. Having evaluated each alternative, the recommended preferred strategy is Alternative L-2: Nitrate Removal System. This alternative has several permitting and staffing issues, but has the potential for a long-term solution to Lockett's water quality problems.

City of Electra

The City of Electra has four viable water supply strategies. Three of these strategies involve purchasing water from Wichita Falls' existing water supply sources, and one involved redevelopment of existing capped wells and constructing an enhanced treatment facility. Having evaluated each alternative and in coordination with the City of Electra, the recommended preferred strategy is Alternative E-1: River Well Fields. This alternative in combination with the water supply from the City's existing lake, will meet Electra's projected water supply needs.

Chloride Control Project

The concentration of dissolved salts, particularly chloride, in the Lake Kemp/Diversion reservoir system limits the use of this water for municipal, industrial, and agricultural purposes. Having evaluated the potential benefits of the Chloride Control Project, and based on the need to reclaim the Lake Kemp/Diversion reservoirs as a municipal water supply for Region B use, the Chloride Control Project is recommended as a regional water supply management strategy. In the long-term it is anticipated that the Chloride Control Project will reduce the cost of water treatment for those entities, which are utilizing the Lake Kemp/Diversion water for municipal purposes, in addition to making more water available for a broader range of agricultural activities.

5.9 Summary of Drought Contingency Plans

Drought Contingency Plans are required of all wholesale and retail public water suppliers and irrigation districts by the Texas Water Code (Sections 11.1271 and 1272) and by TNRCC Rules (30 TAC Chapter 288). These plans must meet specific requirements provided in Chapter 288. In general, drought contingency plans must include, at a minimum, the following elements:

- Provisions for public input in development of the plan
- Provisions for public education regarding the drought contingency plan
- Coordination with the Regional Water Planning Group
- Criteria for initiation and termination of drought response stages
- Identification of drought response stages
- Assessment of water management strategies for specific drought conditions

- Procedures for notification of the public
- Methods for determining the allocation of supplies to individual users (irrigation plans)
- Monitoring procedures to initiate or terminate a drought response stage
- Procedures for accounting for use during implementation of water allocation (irrigation plans)
- Procedures for transfer of water allocations among users (irrigation plans)
- Supply or demand measures to be implemented during stages of the plan
- Procedures for granting variances
- Procedures for enforcement of water-use restrictions

Senate Bill 1 (30 TAC Chapter 357) requires the regional plan to incorporate drought contingency planning into the near-term and long-term strategies to address water supply needs. Chapter 357 also requires existing drought contingency plans to be considered in the development of the regional water plan. In response to these requirements of Senate Bill 1, the Regional Water Planning Group for Region B invited representatives from retail water systems, wholesale water providers, and irrigation districts within the region to a series of workshops on drought contingency planning. The intent of the workshops was to aid the water providers in the development of drought contingency plans for each of their organizations. Most of the region's water systems responded to this process and worked closely with the RWPG to develop appropriate drought responses. Each participant worked with the regional water planning staff and consultants to prepare an appropriate draft drought contingency plan for their water system. Once the governing bodies of the water providers had approved the drought contingency plans, they were submitted to the RWPG, as required by Chapter 288.

A summary of the drought contingency plans currently in effect in Region B is contained in Table 5-2. These plans satisfy drought contingency plan requirements of 30 TAC Chapter 288. Drought contingency triggers for each plan are based on sources, where sufficient source information is available, or on water system constraints. The applicable trigger criteria and response actions are included in the table.